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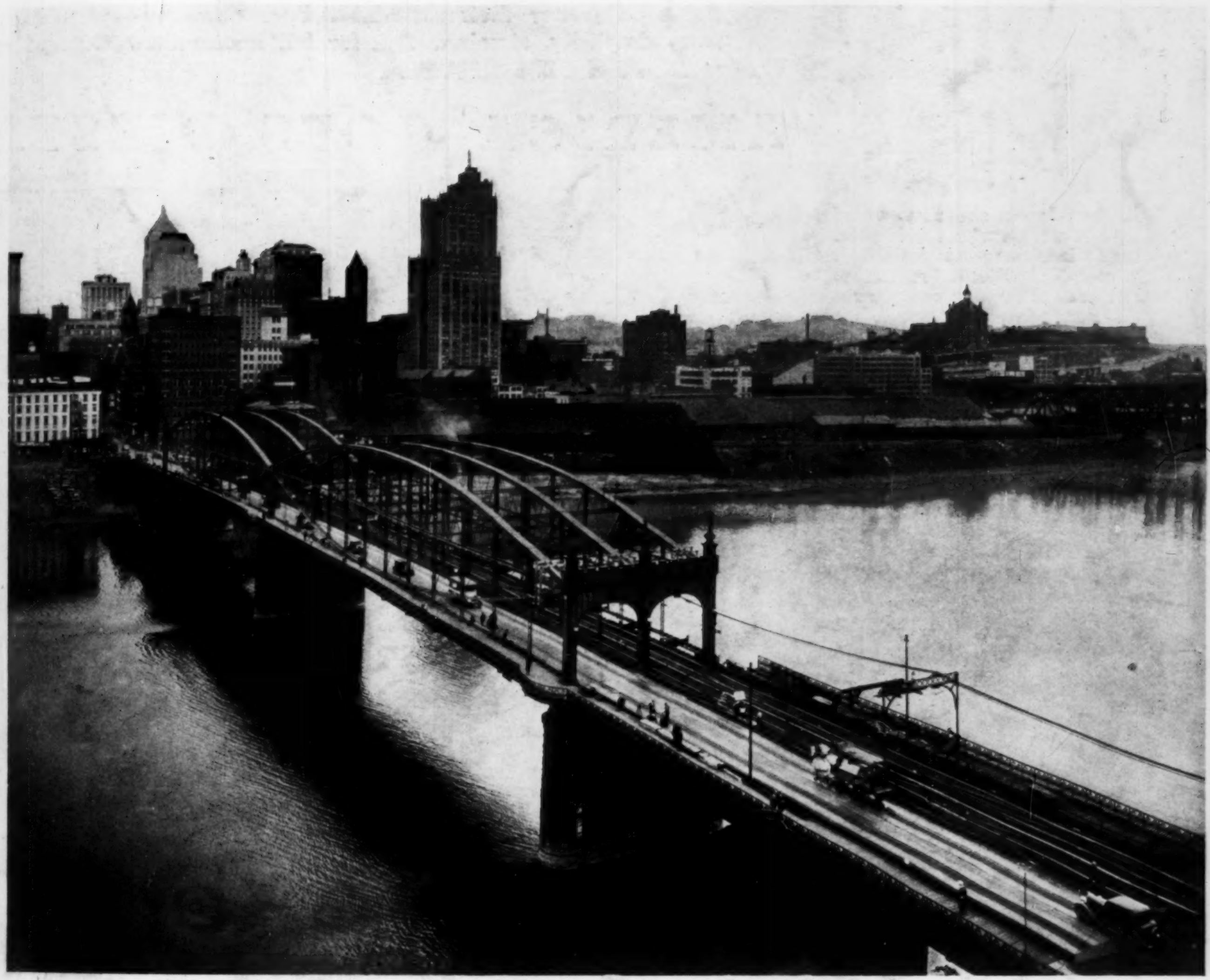

Installing an Aluminum Floor System on Smithfield Street Bridge, Pittsburgh, Pa.
First Application of Structural Aluminum to Bridge Construction

Volume 4 AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852 *Number 3*

MARCH 1934

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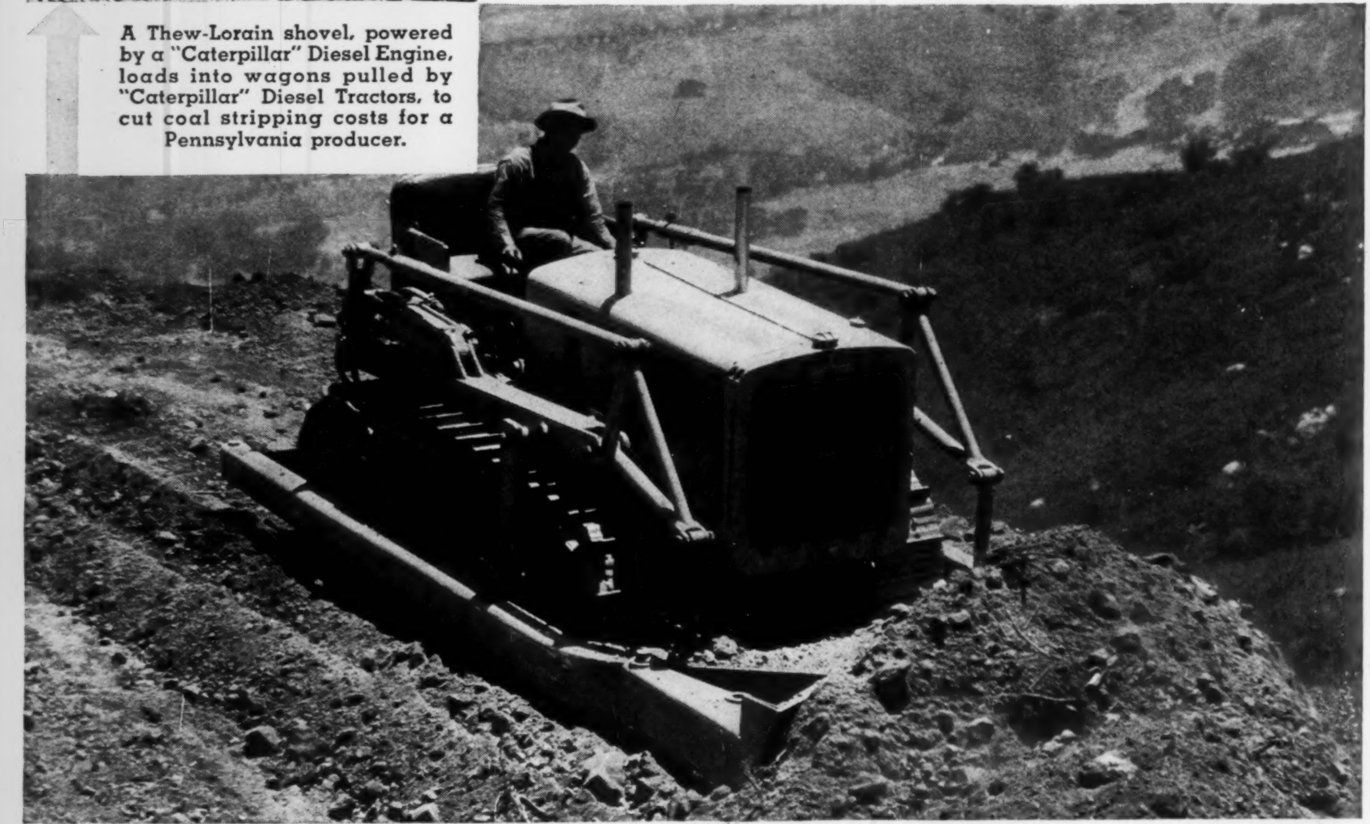

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Among Our Writers

J. P. Growdon has been in charge of the design and construction of numerous hydro-electric power developments in the Northwest, among them the Skagit River Development for Seattle. In 1925 he went with the Aluminum Company of America.

Ross M. Riegel, a Cornell graduate of 1904, has specialized in hydraulic and structural engineering. He served the Miami Conservancy District from 1915 to 1920.

R. L. Templin has been Chief Engineer of Tests of the Aluminum Company of America since 1919. He had a part in the testing of the Liberty motor.

Herbert D. Vogel was sent to Europe by the Corps of Engineers to study river control works and since 1929 has been directing the Corps,, Vicksburg laboratory.

Frederick H. McDonald has a background of commercial law, banking, and corporation finance as well as engineering. He was instrumental in the organization of the Society's Engineering-Economics and Finance Division.

Charles Keller was at one time a member of the Board of Engineers for Rivers and Harbors. During the War, General Keller was Deputy Chief Engineer of the A.E.F. In 1923 he retired from the Army to take his present position.

K. H. Logan has been investigating stray current electrolysis and soil corrosion for the Bureau of Standards since 1911. Previously he had taught physics and electrical engineering in Midwestern colleges.

Benjamin Schwerin has specialized in the structural branch of the profession and for the past 11 years has been with the City of New York on a variety of municipal engineering problems.

A. E. Horst has been with the Henry W. Horst Company since his graduation from the University of Illinois in 1911. The firm's work has been the construction of utilities, sewage works, highways, subways, and housing projects.

Hugh Miller was dean of the College of Engineering of George Washington University from 1921 to 1926. He was taken from a professorship at Union College to become State Engineer (PWA) for Missouri.

Gordon M. Fair has specialized in sanitary engineering. In 1921 he was Assistant Director of Sanitation of the League of Red Cross Societies at Geneva, Switzerland. He has been teaching at Harvard University since 1922.

Herbert S. Crocker, Past-President of the Society, needs no introduction to its members. He is recognized as an expert on both the design and the construction of bridges, and many structures in the West bear witness to his skill.

A. P. Greensfelder is a former president of the Associated General Contractors of America and vice-chairman of the Construction League of the United States. For many years he has been active in Society affairs.

Carey H. Brown, University of Chicago and West Point graduate, saw service in Panama, Mexico, and France. Colonel Brown has been assistant director of Public Buildings and Parks and engineer of the National Capitol Park and Planning Commission.

E. W. James had charge of the surveys for an inter-American highway for the Bureau of Public Roads, which he has served for many years. He has contributed generously to the technical press.

C. O. Sherrill, in the Corps of Engineers for 25 years, resigned in 1925 to become city manager of Cincinnati and is now vice-president of the Kroger Grocery and Baking Company.

Arthur E. Morgan is best known for his work as chief engineer of the Miami Conservancy District and as President of Antioch College.

W. G. Sloan before the War was vice-president and chief engineer of the MacArthur Brothers. Since the War, except for two years, he has been State Highway Engineer of New Jersey.

S. Johannesson, after working on tunnel construction in London, was connected with the Pennsylvania Railroad on tunnel work, and for ten years with subway construction in New York, N.Y.

J. J. Hennebique has spent many years designing and building reinforced concrete structures (Hennebique System). During his construction of a lighthouse in Delaware Bay in 1913, he began his studies of currents and sand movement.

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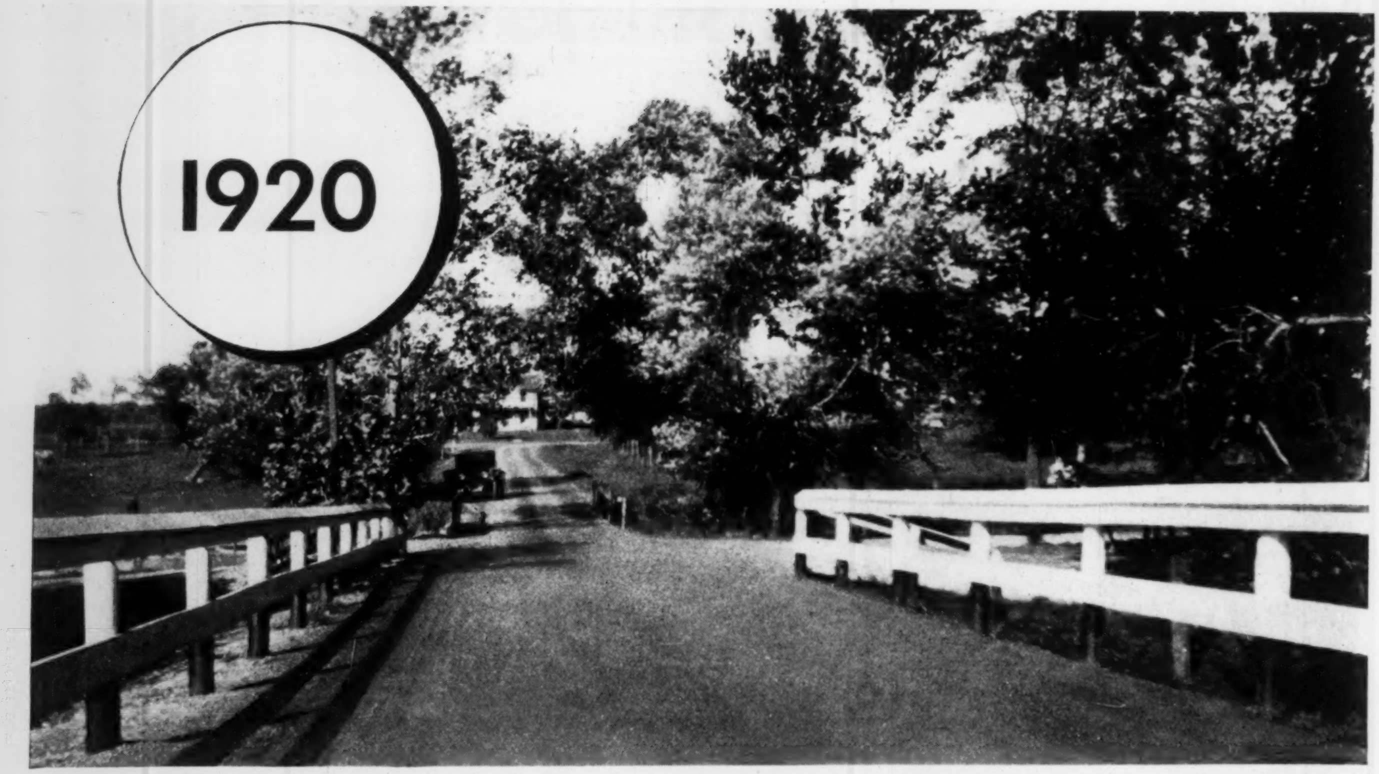

Ida-Maybee Road, Monroe County, Michigan. Water-bound macadam maintained with Tarvia since 1920. The Eighteenth Amendment went into effect that year. Upper photo was taken in 1920; lower photo shows condition of road today, proof that initial investment and maintenance need not be great to produce an efficient, long-lived road.

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NUMBER 3

Heavy Bridge Floor Replaced with Aluminum

Reconstruction of the Smithfield Street Bridge, Pittsburgh, Pa.

By J. P. GROWDON, M. AM. SOC. C.E.
ASSISTANT CHIEF HYDRAULIC ENGINEER, ALUMINUM COMPANY OF AMERICA, PITTSBURGH, PA.
ROSS M. RIEGEL, M. AM. SOC. C.E.
BRIDGE ENGINEER, CITY OF PITTSBURGH
and R. L. TEMPLIN, M. AM. SOC. C.E.
CHIEF ENGINEER OF TESTS, ALUMINUM COMPANY OF AMERICA

STRUCTURAL aluminum shapes were adapted for successful use in bridge construction for the first time when the heavy steel and wood floor of a 50-year-old bridge in Pittsburgh was replaced with 340 tons of aluminum alloy, weighing but one-third as much as steel. Faced with the problem of regulating the loads or building a new bridge to carry the increasingly heavy concentrations of traffic, the engineers of the city decided to reduce the dead load on the trusses. Thus a new structural material was introduced to the profession and the useful life of a bridge was extended by at least 25 years. Details of the design, fabrication, and erection of the aluminum floor, which was installed without taking the bridge completely out of service, are given in this article, read before the Structural Division on January 18, 1934, during the Society's Annual Meeting in New York.

SPANNING the Monongahela River at Smithfield Street in Pittsburgh is a bridge of two identical 360-ft main spans, with deck plate girder approaches, carrying two roadways, one for street cars, the other for vehicular traffic. This structure was designed by, and built under the direction of Gustav Lindenthal, Hon. M. Am. Soc. C. E., who described it in an excellent paper presented before the Society in September 1883.

Because of its age and the heavy live loads imposed by modern traffic, the bridge had become a source of concern to the engineers responsible for its safety. The problem was solved by completely replacing the steel and wooden floor system with one of aluminum, which reduces the dead load on the trusses by more than one ton per lineal foot, thus permitting unrestricted traffic and adding an estimated 25 years to the life of the structure. This work was carried out during October 1933. It is estimated that in 25 years this reconstruction will save the City of Pittsburgh one and a half million dollars, the cost of a new bridge.

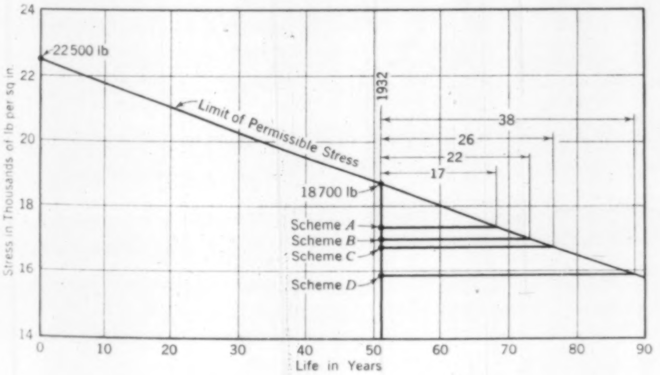


FIG. 1. STRESS-TIME RELATIONSHIP IN CENTER TRUSS
Smithfield Street Bridge, Pittsburgh, Pa.

Five points appear to be of particular interest:

1. The method of analysis, which permitted a logical prediction of increased life due to a reduction of load and stress.
2. The structural use of a new aluminum alloy having the strength of silicon steel with only one-third its weight.
3. Development of a satisfactory bridge deck, permanent, non-combustible, and weighing only 30 lb per sq ft.
4. Use of a bridge railing which is amply strong, attractive in appearance, and moderate in first cost, and which does not require painting or other maintenance.
5. Coordination of design and fabrication with a detailed method of erection, which permitted the completion of the work in a very short time with a minimum of inconvenience to the public.

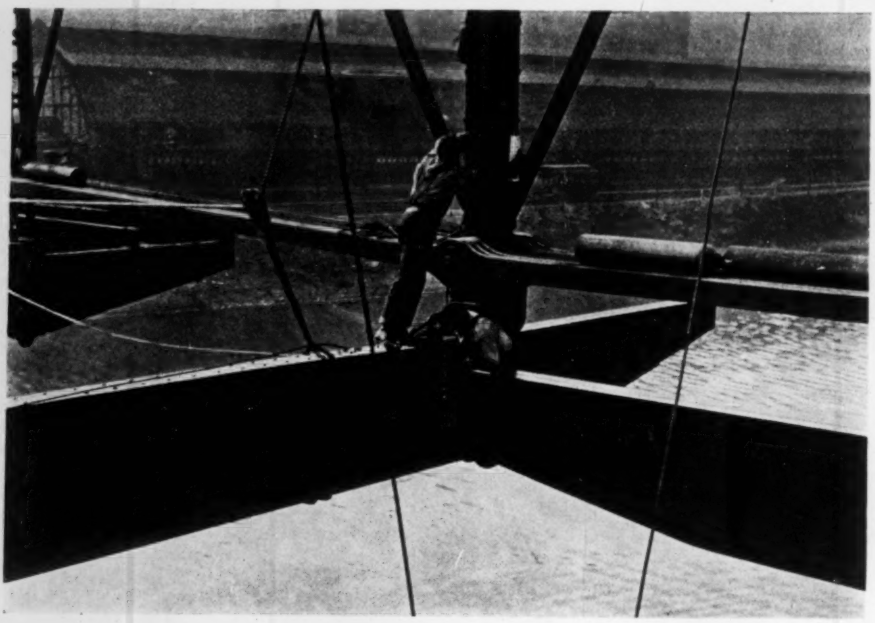
Extensive tests show that in a properly designed structure, such as a bridge, the modulus of failure is a function of the yield strength of the material of which the structure is built. A factor of safety is provided by so designing the structure that under its heaviest loading the stress in any member will not exceed a certain fraction of the yield strength. This fraction and the resulting factor of safety vary with the type of structure, the kind of material, and the judgment of the designer.

Any structure built by man begins to deteriorate as soon as it is completed, through the processes of wear, corrosion, erosion, or decay. Although good design and maintenance can and do delay such deterioration, it cannot be entirely prevented, and lack of maintenance may and often does accelerate it. The strength of a structure must therefore diminish with age.

If a structure is designed for, say, a stress of half the yield point and a factor of safety of two, the factor of safety must continually diminish as time passes, if the loading remains the same. Conversely, the loading must be diminished to retain the original factor of safety.

If the safe stress is determined at any two times in the life of the structure, as for example when it is first built and fifty years later, it may be assumed that the safe stress at any time between these two dates varies as a straight line.

On the assumption that maintenance in the future will be as good as it has been in the past, such straight-line variation may be prolonged into the future and on it may be based predictions as to the period of useful life.



HOISTING AN ALUMINUM HIGHWAY STRINGER INTO PLACE
Length, 27 Ft 5 In.; Weight, 1,200 Lb

This principle is illustrated by Fig. 1 for the center truss of the Smithfield Street bridge, the one most highly stressed. The diagram also shows the predicted increase in life which would have resulted from several methods of reconstruction other than the one chosen. The adoption of Scheme D, resulting in the greatest reduction of load and stress and the longest life, is warranted only on the assumption that the bridge will continue to function adequately for the traffic offered. The City Planning Commission and many others were consulted on this point. Their collective judgment was that the bridge would be adequate because through automobile traffic had been largely diverted to other bridges, leaving only local traffic, which is unlikely to increase. Also, the bridge and a tunnel operate together to carry the South Hills street car traffic. If this traffic should in the future require additional track capacity, it would inevitably be provided at another site.

THE MATERIAL USED

Scheme D, giving the longest life, was based on the use of an aluminum alloy of the duralumin type, commercially designated as 17 ST, which has been used for many years in railway and interurban cars, trucks, passenger automobiles, drag-line booms, and cranes, where it has given an excellent account of itself. After the design had been practically completed, but before the specifications had been written, the Aluminum Company of America offered a new alloy, a modification of the duralumin type, which appeared to possess numerous advantages. This new alloy had been undergoing development and test in the company's research laboratories for a long period and its properties were accurately known. It had been subjected to accelerated comparative tests so that there was no doubt as to its performance compared with the older alloy or steel under severe conditions of stress, fatigue, and corrosion.

The typical physical properties of the new alloy, known as 27 ST, the average of thousands of tests of the material used in the Smithfield Street bridge, are as follows:

Ultimate strength	60,000 lb per sq in.
Yield strength (set = 0.2 per cent)	50,000 lb per sq in.
Elongation	12 per cent in 2 in.
Brinell hardness	118
Modulus of elasticity	10,000,000 lb per sq in.
Coefficient of thermal expansion	0.000012

It can be seen that 27 ST is comparable in strength to silicon steel and may be designed for similar stresses if formulas taking account of its modulus of elasticity are used. It is not easily damaged in the shop or field and is in every sense a tough, strong structural material. It should be a valuable addition to the materials available to the bridge engineer.

The shapes and plate were produced in modern mills at Massena, N.Y., and Alcoa, Tenn., respectively. All the usual structural shapes and plates up to 120 in. in width are available. The material is both heat treated and artificially aged; therefore it cannot be welded or cut by a torch without loss of properties. It can be punched, sheared, and drilled easily, and is not injured by hot riveting. While only limited amounts of forming can be done on the alloy at ordinary temperatures, it has been found that it can be heated to 400 F without injury to its physical properties, and at this temperature its forming qualities are greatly improved.

THE NEW DECK, OF ALUMINUM ALLOY, DESIGNED FOR H-20 LOADING

A wooden floor 11 in. thick was used on the old Smithfield Street bridge. From a traffic point of view, this was not entirely satisfactory. For one thing, maintenance and repair costs were high. The first bridge across the river at this site was destroyed by fire, and all succeeding structures have been fire hazards. The danger is illustrated by the five fires which started in the floor system of this bridge during the summer of 1932, any one of which would have destroyed the structure if it had not been promptly discovered and extinguished.

MADE IN USA
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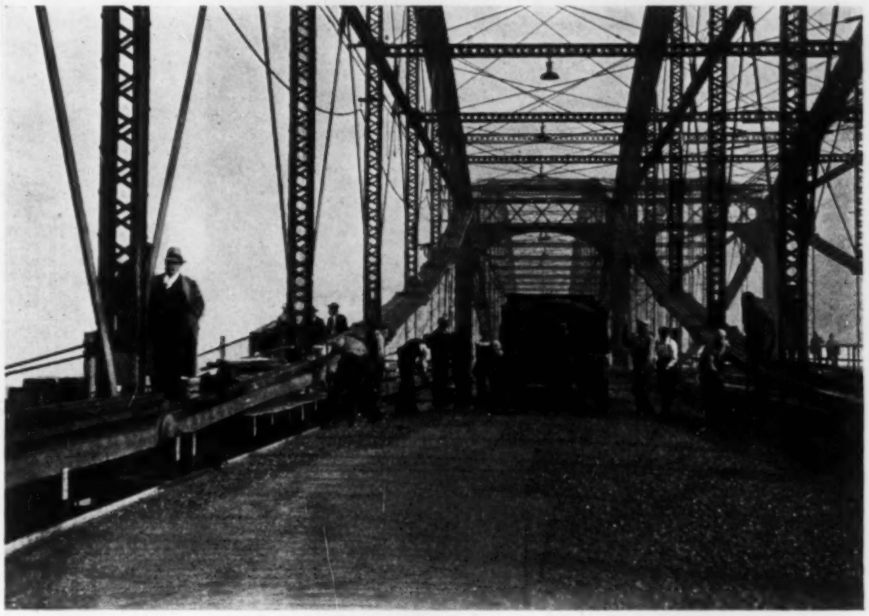
AN ALUMINUM SHAVING
From a $^7/_{16}$-In. Floor Plate

A wooden deck was first proposed for use with aluminum floor beams and stringers because no other satisfactory type of floor was known which would come within the weight requirements. The Aluminum Company studied several types of bridge decking, from which they finally selected two for test. After comprehensive tests of panels 11 ft wide by 13 ft 10 in. long, involving measurement of stresses and deflections in every part of the structure under H-20 loading, and a service test which consisted of driving an H-20 truck across the test panel 6,300 times in one direction, the battle-deck type was selected for the Smithfield Street bridge.

As originally designed, the battle-deck floor was made in two panels, each 5 ft 6 in. wide and 13 ft 10 in. long, which were shop fabricated and joined together in the field to form the test section. One panel consisted of tread plate $^1/_2$ in. thick, supported by, and riveted to 8-in. channels spaced 11 in. apart, with a channel under each edge. The rivets connecting the plate to the channels were spaced 9 in. apart. The second panel was a duplicate of the first, except that the tread plate was $^7/_{16}$ in. thick. The adjacent channels under the edge of the plates were field riveted. The test section thus formed was installed over a pit in a roadway at the New Kensington works of the company, where it could be conveniently tested under actual truck loads and service conditions. The test section spanned the entire pit, which was 13 ft 10 in. across, without intermediate support. It was felt that this long, unsupported span would be too flexible to be satisfactory, so a central support was provided, which could be used if required.

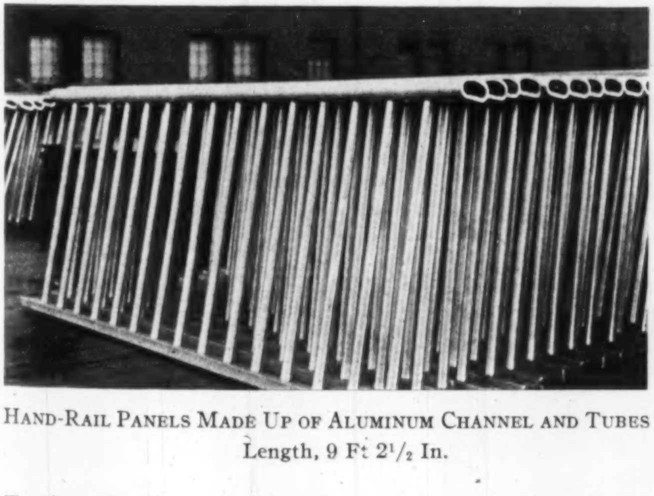


Asphaltic Wearing Surface $1^1/_2$ In. Thick, Being Placed Cold
Smithfield Street Bridge, Pittsburg, Pa.

It was realized that differential deflection of adjacent joists under concentrated wheel loads would not only result in very high stresses in the plate but might cause the wearing surface to crack and disintegrate. To prevent this local differential deflection without spacing the floor beams very closely, an 8-in. channel was placed below, and at right angles to the joists, to which it was rigidly attached by short angles and rivets. Two of these distributor channels were provided, spaced 4 ft 7 in. from each end.

STRAINS MEASURED IN THE LABORATORY

Accurate measurements of the strains, from which the stresses were computed, were made by the Physical Testing Division of the company's research laboratories. Measurements were also made of the deflections of every part of the structure under H-20 loading, with the rear wheels in every possible position. As a result of these tests it was found that the distributors caused the entire structure to deflect with great uniformity, transferring the load from the joist immediately under the wheels to all the other joists.



Hand-Rail Panels Made Up of Aluminum Channel and Tubes
Length, 9 Ft $2^1/_2$ In.

Deflections of the whole section, acting as a simple beam with static and moving loads in the center, were respectively 0.55 in. and 0.60 in., or $\frac{1}{302}$ and $\frac{1}{277}$ of the span. This deflection was scarcely noticeable and was entirely satisfactory in service.

In the test panel the maximum stresses were as given in the following tabulation:

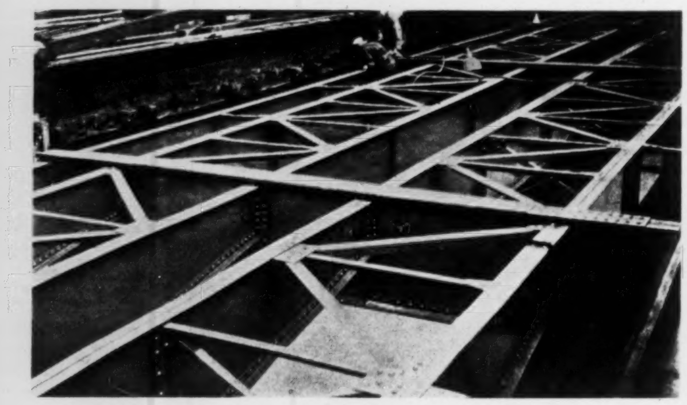
8-in. distributor channel	8,300 lb per sq in.
8-in. joist	17,700 lb per sq in.
$^7/_{16}$-in. tread plate	21,400 lb per sq in.
$^1/_2$-in. tread plate	17,000 lb per sq in.

Since the stresses to be used in the design for the Smithfield Street bridge were limited to 15,000 lb per sq in., it was readily apparent that either a thicker plate must be used or the joist spacing reduced. The latter method proved the more economical. With an 8-in. spacing and a shorter span, the joists would be under-stressed and could be reduced in size. The distributor was also under-stressed but was left unchanged, since its effectiveness depended on its stiffness.

It was also seen that riveting the joists together at the splice did not provide perfect continuity. This was corrected by substituting a double butt strap splice in the plate. When tested, this was found to be entirely adequate. In the light of the information gained under test, the floor was redesigned with complete confidence that it would perform exactly as intended. The development of this floor illustrates the advantage of utilizing test measurement instead of computation wherever possible.

As built on the bridge, the battle-deck floor is continuous throughout the entire span. This permits the tread plate to take negative bending moment over the floor beams, reducing both stress and deflection. The continuity in this system also provides lateral stability to the bridge without wind bracing and makes expansion joints unnecessary except at the ends of the span.

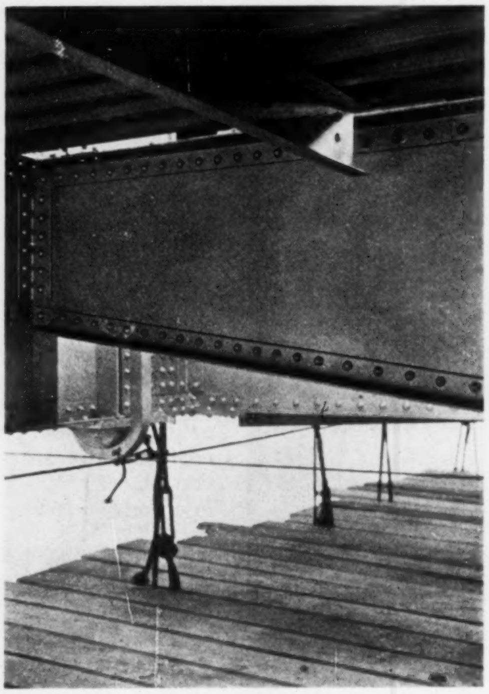
Tread plate was used so that the embossed parts would provide an anchorage for the wearing surface. This was perhaps unnecessary since the rivet heads are sufficiently numerous to answer the purpose.



ALUMINUM FLOOR SYSTEM READY FOR PLACING OF TIES ON STREET RAILWAY SIDE OF BRIDGE

The part of a bridge that is subject to the least load, and that most infrequently, is the railing. But unreasonable as it may appear, this part often requires the most maintenance. Its repair is expensive and seldom adequate, so that corrosion and unsightliness result. Since some of the strong alloys of aluminum are extremely resistant to corrosion, many designs were worked out in an endeavor to utilize them in a railing that would have the required strength and be pleasing in appearance, relatively cheap to produce, and simple to erect.

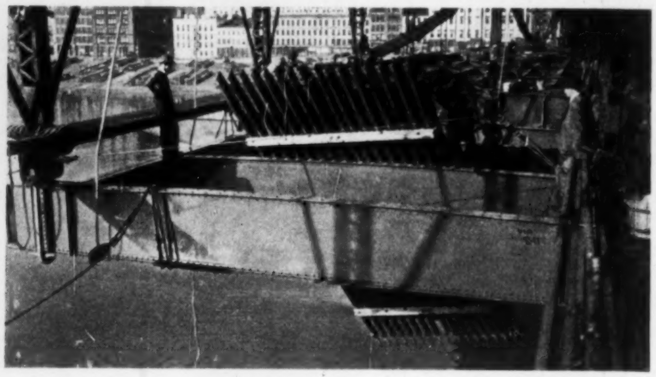
As a result of these studies the Smithfield Street bridge railing was designed. It consists of 5-in. H-beam posts riveted to the fascia girders; of a 5-in. oval tubular top rail, with a $^1/_8$-in. wall, reinforced at the ends where it rests on a seat welded to the top of the post; and of a 4-in. channel bottom rail, which rests on angle seats riveted to the web of the posts. The top and bottom rails are connected by $1^1/_2$-in. round tubular balusters, spaced $6^3/_4$ in. from center to center. The balusters were inserted in holes punched in both top and bottom rail, where they were fastened by expanding them in the same way that a boiler tube is expanded into the shell. Thus the rails and balusters make up a shop fabricated panel 9 ft 2 in. long and weighing 45 lb. Its erection was simple. After the posts were riveted to the girders, it was only necessary to set the panel in place, bolt the bottom rail to its seat, place the cap on the post over the top rails, and drive four $^1/_2$-in. aluminum rivets. The top rail will sustain a horizontal load of 362 lb per lin ft without the stresses exceeding the yield point.



FLOOR SYSTEM OF SMITHFIELD STREET BRIDGE
First Application of Structural Aluminum to Bridge Construction

For the top rail and balusters, 4 SH alloy was used, and for the bottom rail and posts, 53 ST alloy. Painting is not necessary. The railing will retain its original strength and appearance for an indefinite period without any maintenance expense whatever, except the cost of an occasional washing to remove atmospheric dirt, if this should be considered desirable. Because of its simplicity and light weight, the cost of this railing is comparable with that of other commonly used types.

A large number of pedestrians use the Smithfield Street bridge, many of them commuters from residential districts both east and west of Pittsburgh. It is also used by practically all the street cars serving the large South Hills residential district, and by local automobile and truck traffic. Vehicular traffic can be detoured over other bridges without too great inconvenience, but it is wholly impractical to detour either pedestrians or street cars. This consideration was of paramount importance in every phase of the reconstruction. All the possibilities of the old structure and the new material were exploited to reduce traffic interruption to a minimum, both in the design and in the schedule of erection, which was worked out in detail before the contract was let.



SECTION OF ALUMINUM HIGHWAY FLOOR BEING HOISTED INTO PLACE
Weight of Section About 3,900 Lb

Since the two roadways had been built at different times and the floor beams were spliced just upstream from the center truss, it was easy to transfer pedestrians to the west sidewalk and the street cars to a temporary track laid directly on the wooden highway deck, thus freeing the upstream half of the bridge. The old floor system on this half was removed piece by piece, beginning at the center of each truss, and was immediately replaced with the new aluminum members. The old and new floor beams were connected by a temporary hanger, which could be easily removed. By the time the last stringer was in place, the ties and rails had been relaid, and the east sidewalk was ready for traffic. In nine days the street cars were returned to their original place and the new aluminum structure was in service.

The west sidewalk and highway track were then closed, the temporary track and timber deck removed, and the same process repeated on the other half of the bridge. It was necessary to support one end of a street car floor beam on a temporary truss extending across two panels while the old roadway floor beam was removed and a new aluminum floor beam was put in its place and riveted. The placing of stringers and roadway deck followed the laying of the floor beams, and was followed in turn by riveting. When this was completed the asphaltic concrete wearing surface was added.

Automobile traffic was interrupted for 24 days; street car and pedestrian traffic not at all. This very satisfactory performance was made possible only by the whole-hearted cooperation of the city's engineers, the contractor, the producer and fabricator of the material, the street car company and other utilities using the bridge, and the U. S. District Engineer. The new floor system was fabricated in the largest units that could be conveniently handled. The sidewalk was shipped in complete panels, 27 ft $7^{5}/_{8}$ in. long, the highway deck in panels 11 ft wide by 27 ft $7^{5}/_{8}$ in. long, and other members in similar fashion wherever possible.

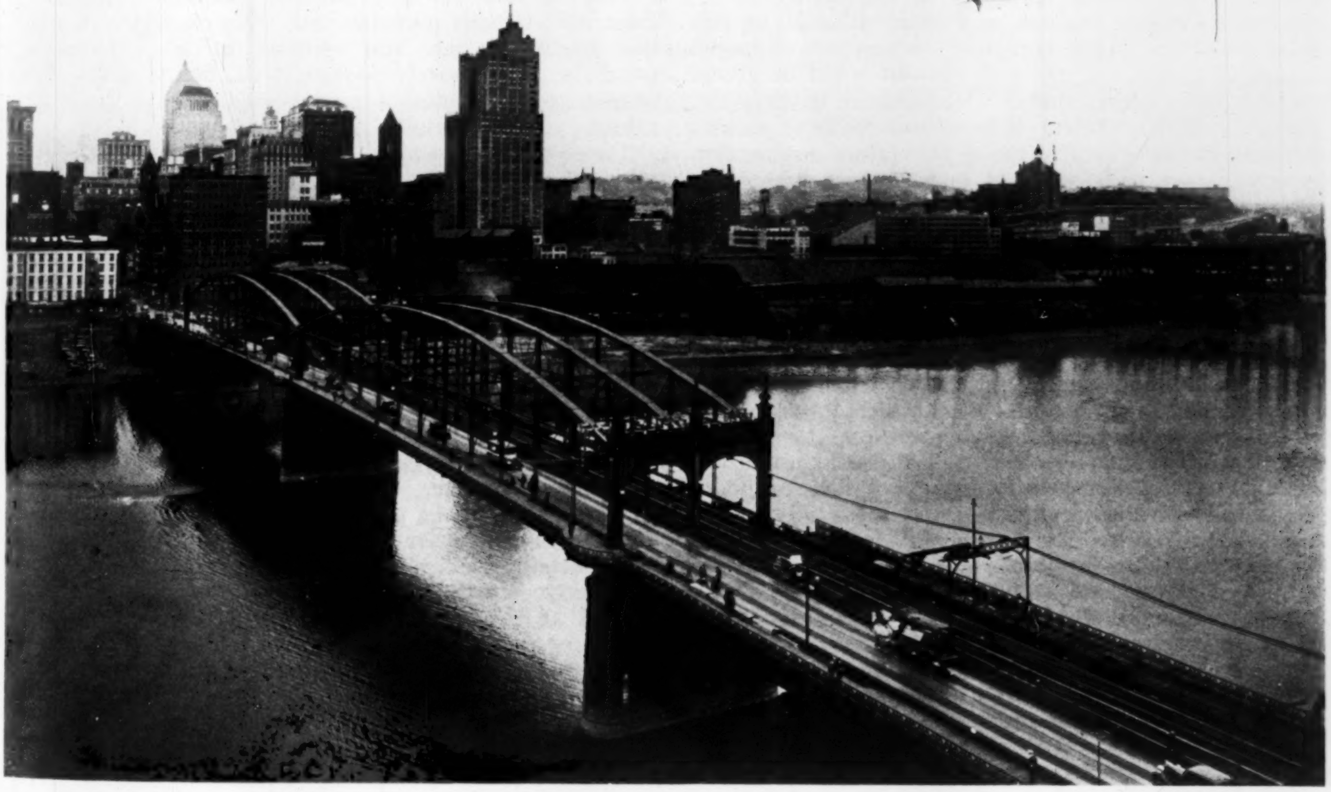
A complete erection schedule was worked out showing in detail the sequence of every operation, the kind of equipment, the number of men, and the time required to complete it. The contractor studied the work in advance and always had at hand equipment and skilled workmen when they were needed. The aluminum was produced and shipped strictly according to schedule. The fabricator, handling a material new to him, performed all the complicated operations required to make the shapes and plates into bridge members, which were delivered exactly as required for erection.

The street railway company provided the large crew and expert supervision necessary to take up, move, and re-lay its tracks in the minimum time. Also, telephone and power cables were moved and a gas line taken down and replaced so as to cause the least possible interference with the work. The U. S. District Engineer permitted barges to be anchored in the river under the bridge. These were used to receive the old material and deliver the new. As reconstructed, the bridge is entirely satisfactory and will continue to serve the citizens of Pittsburgh for many years to come.

SOMERS-FITLER

Roadway Members Made Up of Aluminum Shapes and Plates
Designed for H-20 Loading

Needless to add, the preparation of this article as well as the successful completion of the work was made possible by the hearty cooperation of a large number of people, whose assistance is gratefully acknowledged.



Smithfield Street Bridge, Pittsburgh, During Rebuilding of Floor System
The Two 360-Ft Spans Were Constructed in 1882

Practical Value of River Model Studies

Results Obtained at U. S. Waterways Experiment Station Aid in Channel Improvement

By HERBERT D. VOGEL, M. AM. SOC. C.E.

FIRST LIEUTENANT, CORPS OF ENGINEERS, U. S. ARMY; ASSISTANT TO PRESIDENT,
MISSISSIPPI RIVER COMMISSION, VICKSBURG, MISS.

In providing a navigable channel 9 ft deep and 300 ft wide in the Mississippi, standard practice is being followed, but many unusual and baffling conditions, requiring laboratory study, are being referred to the U. S. Waterways Experiment Station for its recommendations. Construction is being guided by laboratory experiments, and the accuracy of the model predictions is being checked by the works actually constructed on the river. This article has been abstracted from the complete paper presented before the Waterways Division at its meeting on January 18, 1934, during the Annual Meeting of the Society.

WHAT reliance can be placed by field engineers on the results obtained from model studies, and what proof exists of the statement that a river will react to treatment the same as its miniature in a laboratory? These are the questions most frequently asked of those engaged in the task of wresting river secrets from small scale models, and strangely enough they are the most difficult to answer convincingly—not that insufficient work has been done in laboratories to afford proof of one kind or another, but that possitive data and positive facts are so few in the general case as to make positive proof next to impossible. At the Fifteenth International Congress of Navigation held in Venice in 1931, this subject was treated by many authors, but only one or two had the hardihood to cite definite cases for comparison. That German paper which treated the subject most boldly offered as one of its strongest bits of evidence the experiments conducted in the Hydraulic Laboratory of the State University of Iowa for determining the spillway discharge of Keokuk Dam.

There are many reasons why it is difficult to cite actual instances of the complete verification of model findings in nature. If no such reasons could be given, it would follow either that model tests are entirely unreliable, or that no attempts had been made to present evidences of agreement. Since the latter assumption has been shown to be in error, and the best authorities agree that beneficial results may be obtained from a well-conducted model study, it remains to cite a few of the more common reasons for the difficulties that have been encountered.

In the first place, only the more difficult problems are submitted to the laboratory for analysis by experimental means. This is of course quite natural, as there is no reason for making model studies of problems which present no doubtful elements, or for which a satisfactory practice has already been established. In the second place, most of the problems submitted to the laboratory are accompanied by schedules of detailed proposed plans, each of which is to be tested separately in the model. As a result of the experiment it may be found necessary to modify some of the plans in order to find one or more which will produce the desired results. By the time any one of these plans has been accepted and instituted in the field it has almost invariably been somewhat further modified to suit changed local conditions. Naturally, the difficulty of comparing the effects of the improvement as finally completed with the effects in the model increases with the degree of modification.

Thirdly, the time required in nature for a structure to become effective differs greatly with its type and with local conditions. For instance, works designed to produce changes in the river bed by inducing deposition of silt would become effective more quickly on the heavily silt-laden streams of the West and Southwest than on such comparatively clear rivers as the Ohio and the Upper Mississippi. Spur dikes to increase the depth of the channel at low water by their scouring action, if properly located, become effective relatively soon in rivers having muddy or sandy bottoms, but in localities where there are deposits of gravel it may take a much longer time for such dikes to bring about the desired effect.

Experimental work at the U. S. Waterways Experiment Station was begun in January 1931, and the first experiments were not completed until between six months and a year later. A similar period of time necessarily elapsed before any of the works tested in these experiments could be installed. As a result, sufficient time has not yet elapsed to demonstrate conclusive results in every case, although the next two or three years should provide very definite information as to the reliability of the several types of models employed, including river models with movable bed, river models with fixed bed, harbor models, and spillway models. However, proof is not entirely lacking; in many cases field checks on the results of model studies have been obtained, either partially or completely.

Those problems which have most readily lent themselves to subsequent verification in nature are the ones which have had for their purpose the determination of methods for improving low-water navigation channels, such as those of the Fort Chartres and Brooks Point reaches (Upper Mississippi River); the Island No. 9, Hotchkiss Bend, and Point Pleasant reaches (Lower Mississippi River); and the Walker's Bar reach (Ohio River). Surveys after completion of the works in nature have, in these cases and many others, revealed a remarkable similarity to effects predicted from the model studies. Equally close verifications have been made in the case of cut-off studies and investigations of a similar character; effects observed in nature at the present time closely parallel the results anticipated as an outcome of earlier model studies.

No attempt has been made to present an inventory of field verifications for the model investigations conducted at the U. S. Waterways Experiment Station. In many cases sufficient similarity has been observed in nature to compel faith in results of the tests. In rare instances, verification has been more difficult—if not altogether too difficult—to obtain. The main point to note is that the science which was a veritable infant only a few years ago is now a lusty youngster, rapidly coming of age, whose importance must soon be universally recognized.

The Government in Business

An Equitable Theory Based on Self-Supporting Rate Structures and Cooperation with Private Enterprise

As citizens, as taxpayers, and as professional and business men, engineers are concerned with the present tendency of government to engage in business, particularly in widespread power production. The effect of this trend on private investment, on individual initiative, and on ultimate cost to the taxpayer is here analyzed by Mr. McDonald. He believes that if publicly owned revenue-producing facilities are to be fair to the general taxpayer, then equity would require that a self-supporting rate structure be a mandatory condition. A wider and more rapid benefit for the people can be gained by a cooperative and noncompetitive effort between government and private enterprise. He proposes a national network of distribution lines connecting the lines of private companies, the Government to furnish primary power from the Tennessee, the Colorado, the Columbia, and the St. Lawrence rivers, and the private companies to act as distributors and to supply the stand-by power from existing plants. He also proposes the electrification of a unified railroad system to constitute a large user. By this and other means power consumption might be so increased as to permit a nationally uniform domestic rate structure of less than two cents per kilowatthour.

In the second part of this symposium, Mr. Gifford considers the possibility of making self-supporting rates mandatory under existing laws. His conclusion is that there is no precedent to indicate that a court would interfere with the operation of a legally authorized, publicly owned enterprise even though it resulted in losses which had to be covered by tax levies.

As explained in the third article of this symposium, an experiment in Government operation and control of a public utility—the activities of the Inland Waterways Corporation on the Mississippi River—has been under way since 1918. Applying the principles enunciated by Mr. McDonald to this corporation, General Keller concludes that additional time will be required (about four years) to determine whether the operation of barge lines on the Mississippi is a profitable enterprise for the employment of private capital.

An Equitable Theory of Governmental Ownership and Operation

By Frederick H. McDonald

Member American Society of Civil Engineers
Consulting Engineer, Atlanta, Ga.

ONCE the individual, his private affairs, and the enterprise developing from his energy, initiative, and imagination, were his own concern. Now the teaching and the correspondingly based legislation face us that the interests of the individual must be submerged completely in those of groups or of society at large. Suddenly, government and the action of government form the regularly dominating headlines of the news. Today government is undertaking to control the progress of business; it threatens to control the actions and the affairs of the individual.

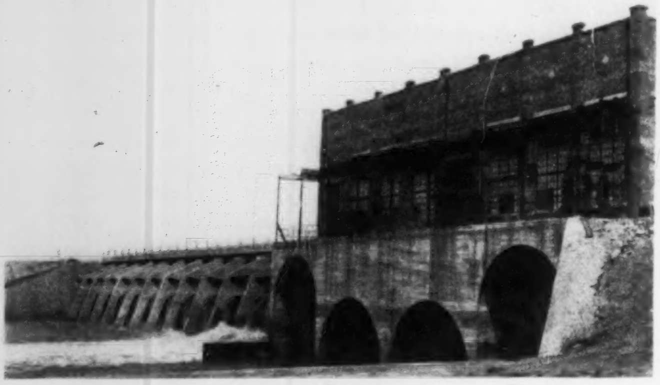
The most discussed, the most inescapable, and the most outstanding fact that faces us today is this momentary dominance of government in the affairs of the individual and the shadowing trend of such dominance to become all enveloping. From the standpoint of the individual, there are two factors in this condition which influence his acceptance or his opposition. The first of these is the restrictive effect on his latitude, enterprise, and business. The second is the cost to him of this governmental control, regulation, and direction. The cost of these is a by-product. But in this very measure of costs, and in the possibilities for their reasonable limitation, may be found both a brake and some control on the extent of the effort of government in business.

The direct cost of government is evidenced in the kinds and in the amount of taxation. Vast as is the now staggering cost of this apparently devouring creature of government, it must be realized that it all has been largely of the people's devising. Yet, in their panic of realization, they must not tear down as recklessly as they have permitted growth. Government offers much that is needed. For example, picture a community congested, concentrated, throbbing with business and social life, yet with no central water supply, no sanitation, no police or court protection, no fire protection, no public school system. These are the kinds of things that are fundamental to community life and of direct benefit to all. They are the true functions of government. If present standards of growth and development are to be preserved, this thing of qualifying what has been built must be gone about carefully, lest the real progress already made be destroyed. The same is true of the attitudes of government toward business.

There are two rightfully reducible costs of government. One is the diminishing of the volume of unreasonable personnel and expense in even the necessary activities of government. This is a matter of efficient operation, and the pressure of a determined electorate inevitably will produce substantial economies in this field. The other opportunity is in the elimination of the unjustifiable and the unlegal activities or costs of government.

REVENUE-PRODUCING ACTIVITIES OF GOVERNMENT

The most obvious of the inequitable charges on the general taxpayer are those costs of governmental agencies that have entered into revenue-producing activities where the charges made to consumers are insufficient to meet the costs of operation. Whether these be postal services, water works, power and light, waterways, barge lines, or other forms of governmental ownership and operation, it is a rare case where the basis of revenue charges is sufficient to meet all proper costs. Almost universally, the general taxpayer is forced to contribute in some degree toward the making up of deficit charges, which become actual subsidies or gifts to the users of a service for which insufficient charges are being made.



COUNTY-OWNED HYDRO-ELECTRIC PLANT, ON FLINT RIVER, GEORGIA

Placed in Operation by Crisp County Hydro-Electric Power Commission in August 1930. Cost, $1,500,000; Normal Head, 30 Ft; Initial Installation, Two 3,600-hp Turbines

Where governmental agencies are engaged in the operation of revenue-producing services, the minimum selling basis of the services mandatorially should be sufficient to pay all costs, including operating costs, interest, refunding or depreciation charges, and taxes. Only such a conception could be sustained as an equitable theory of governmental ownership or operation.

Actually, revenue-producing services provided by governmental or state subdivisions are not truly governmental functions. The benefit is not general in nature; it is not usable as a benefit by all taxpayers. The benefit is specific and is confined solely to the consumers, who in all equity should pay at least the full cost of service.

Even in the extreme case where every citizen is a user, the benefit still would not be general, but would be specific in that some would be greater users than others. To the extent that the full cost is not met by charges directly to consumers, the deficit would be made up by tax costs on the general community. In this case, the larger the user, the greater the individual donation at the expense of both the average user and the general taxpayer.

SELF-SUPPORTING RATE STRUCTURE SHOULD BE MANDATORY

Common practice, as in sewer and paving assessments, already has recognized the equity of some allocation of charges in proportion to benefit. But by local legislation the bureaucratic tendency of government has extended itself, unchallenged by constitutional right, to other lines which are specific and are limited in their benefits to individual users. It is in this field that governmental operation either can be curtailed to the benefit of the general taxpayer or can be made the basis of a fair allocation of all cost charges directly to the consumer of such specific services.

It would seem to be a sustainably equitable theory that a self-supporting rate structure can be made a judicially mandatory condition of the governmental ownership and operation of revenue-producing facilities. Once this principle, voiding the legislative encroachment on our presumed constitutionally vested rights of individual justice, is established as a basis of governmental operation, obviously beneficial results will follow. It would seem an equitable assumption that any non-users of service from a government-operated facility, who are paying taxes to make up deficit operating charges, could apply for relief in any court of equity and that justice would require that the local rate structure be made sufficient so that those who use the service would support the full cost of operation, while those who do not or cannot use it would be freed from any burden of its costs. It would seem reasonable that not only a theory, but the mandatory need as well be developed for governmental operations to be self-supporting by direct revenue from those using the services of the governmentally owned facilities.

EFFECT OF GOVERNMENT LOAN DEFAULTS

Additionally, with all proper charges included in both forms of operation, the great argument of private industry as to the inefficiency and ineffectiveness of governmental operations will receive its full and ample test. Unless private enterprise prove itself more efficient and more effective, government under these conditions should compete with it.

From these considerations, based on the fairness of the allocation of the cost of a growing trend for ownership by government, principles should be developed which will lead to a clear conception of the avenues and the kinds of things in which government equitably may participate. If this can be done, some of the enveloping processes of government may be limited, leaving that much more to the free functioning of the individual.

This is particularly important considering the growing trend found in the central government today to direct tax revenues into business channels. So far these have been largely in the form of loans. Yet, almost without exception, with every loan has gone some restrictive condition as to supervision, or as to the right of approval of actions of the borrower. This amounts virtually to the beginning of some form of control of the actions of the borrower and of his business. By a failure to meet these loan requirements as to payment of principal and interest, the government will become a total or part owner in the business affected. This possibility is without regard to and beyond that of the accompanying tendency of the government itself to conduct the business operations.

The largest of all the fields of governmental operation, actual and threatened at the moment, is the field of power production. Not only has the National Government started in this business on a scale that until recently would have been thought unlikely, but in numerous local communities throughout the land the question of public power production has become a matter for discussion, and in numerous discussions, a major issue.

POLITICAL ASPECTS OF PUBLIC POWER PRODUCTION

Much of this governmental trend to enter the power business can be said to be political. Underlying any general political movement, however, there must be some evidence of public thought or desire on which any achieved political move must be based. Much of this movement at present might be said to be a by-product of previous attitudes of power companies toward the public, which have resulted in a demagogically fired conviction that all the public is in all cases exploited for the benefit of the operators of these utilities. So much has this been a prevalent and accepted premise that the national political proposal to develop publicly owned power-producing and selling facilities, as a yardstick or measure of the rate structure by which private ownership should operate and distribute its product, has been widely accepted.

Men of standing, leaders in their communities and in the Nation, propose to substitute a form of governmental ownership for the present one of complete governmental regulation by state commissions, because the latter has in their estimation failed to produce desired results under a scope and breadth of regulatory control that could not be exceeded, as far as the capacity to install proper rates is concerned, even by outright ownership.

Presumably to demonstrate the politically pictured ineffectiveness of local governmental regulation by another political yardstick for rate structures, the Federal Government has gone, and is going extensively into the business of power production. The Tennessee Valley Authority has been created to own and control the development of the entire Tennessee River, based on Muscle Shoals as the initial development, which contemplates an eventual production of from three to four million horsepower. Accompanying this, Boulder Dam is already started; development of the Columbia River, in the State of Washington, already is authorized; and that of the St. Lawrence River, in New York State, is officially projected.

PRIVATE INVESTMENTS SUBVERTED

In all these cases, the areas surrounding these large reservoirs of promised new primary power are now adequately served by private investment in power-producing facilities and distribution lines, operating under rate structures stipulated by local governmental regulatory bodies as fair and reasonable, and which have been sufficiently acceptable to industry to have provided for the creation of an industrial capacity in this country actually in excess of the Nation's developed capacity to consume.

In each of these areas, the production of federally owned power threatens either to be superimposed on the existing public-utility capacity, thus constituting a waste of taxpayers' money; or it threatens to invade by appropriation the field of an adequately supplied market, and in the process to destroy at least the equity which private enterprise has in its generating equipment. Under what is known of present planned procedure, there does not seem any escape from the result of either of these destructive courses; for even the assumption, for instance in the Tennessee Valley, that an effective amount of new industries and new consumers can be brought quickly to the area, must carry with it the destructive effect either of adding a new industrial capacity to the already over-developed capacity of the Nation, or of moving existing industrial capacity from other sections of the country and creating all the dislocating effects and local hardships of such movement.

In fairness it must be said that deliberate destruction of values could hardly have been the original intent of those creating the Tennessee Valley Authority, or of those interested in authorizing the other large power developments to be carried out by the Federal Government. For the Tennessee Valley, the most constructive type of intent has been thoroughly evidenced in the type of personnel the President has selected and in the enlightened attitude for cooperation as against destruction which these men of his selection are showing in carrying out the legislation enacted by Congress.

Regardless of the original intent in creating these immense projects, however, there can come a time when, facing an audit of performance, the political policy responsible for this performance must undertake to show such favorable aspects as may be achievable, at whatever cost. This means, for instance, that the Tennessee Valley effort at some point can reach a stage where, regardless of the effect on local private investment, it will be almost impossible for those in charge of this operation to avoid the necessity of acquiring some appreciably large market that will enable them to proclaim this effort as having been at least partially successful. Considering the present status of both national and local business, this does not seem within the range of reasonable achievement without the destructive effect on existing private enterprise already suggested.

In fairness to those in the Tennessee Valley Authority who, with conscientious effort, are probably putting their hearts and the results of a life work of experience and broad vision into the Tennessee Valley program, and also in fairness to the justifiable private enterprises now in this area, it seems drastically necessary that some alternative procedure should be advanced that would have a better chance of achieving constructive use of this power as against the hazard of the destructive appropriation of markets. If this can be done it would be a public duty to crystallize and to support such a program.

When uneconomic duplication in railroad operations is eliminated, a density of combined traffic will result that will make the electrification of every mile of railroad in the United States imperative for mere economy's sake. Muscle Shoals can be developed and used as the first generating unit of a nationally inter-connected power system, based on this unit and on Boulder Canyon, the Columbia River, and the St. Lawrence River as run-of-the-stream sources of primary power. A large consumer could be a nationally unified, non-competitive railroad system, electrically operated to give the lowest transportation costs in history. The actual function of power companies can be confined to supplying stand-by power, and to the intensified distribution and sale, for every use, of power throughout the Nation. The resulting expenditure of billions of dollars in the production and installation of the necessary electrical railroad equipment alone would react in every avenue of business and would create one of those continuous new industrial activities sought by all to pull the country out of this depression, as the railroad construction era, the automobile, and other timely activities seemed to pull us out of preceding depressions. By power unification, a constructive, equitable, and sound solution for the problem of Muscle Shoals and of all the nationally owned power sites rises above local problems and creates a national opportunity.

All the evidence of rate trends in power distribution has indicated that the lower the rate the greater the consumption of power. In this simple fact may be the key to the possible constructive use of Muscle Shoals, Boulder Dam, the Columbia River, the St. Lawrence, and all the large river reservoirs of basic primary power.

If the Government, instead of being competitive with business, would use its influence and unlimited resources in the aiding or subsidizing of business to accelerate general-welfare benefits more rapidly than private capital can afford, then a constructive result might be anticipated, as against an almost certainly destructive one.

In effect the Government could say to the power companies:

> Organize your properties for a coordinated, unified, national network of distribution lines with the least costly and the most

> efficient operating structure. We will develop the basic primary horsepower necessary; you will use your present installed capacity as a stand-by, and to make up the difference between what we can produce economically and what is necessary. Until such time as with our cooperative direction, the use of power becomes sufficiently general to develop for you a reduction of operating costs, giving you a basis for profit, we will absorb the losses caused by installing now a promotional scale of nationally uniform rates, so that every domestic consumer in the land in five years can buy power at an average rate of two cents per kilowatthour or less. To accomplish this we will deliver primary power to you at a cost that will make your interim operations possible, even if we have to deliver it free of cost and subsidize some of your operations under, however, the lowest possible agreed basis of fair return on your justifiable investment.

This would mean that the Tennessee, the Colorado, the Columbia, and the St. Lawrence rivers would be developed according to some sane measure of nationally developed need, and the power companies would become distributors and intensive sellers of power. The public at large, while perhaps contributing the tax costs in a period of deficit operation, would know that it was on a temporary basis; that there was no destruction of private enterprise; that a definite and sound objective was being sought; and that eventually all the Nation, instead of just a few local consumers, would be better off economically, financially, and socially.

COMBINE BENEFITS INHERENT IN PRIVATE AND PUBLIC OWNERSHIP

To make effective the operation of such a large and complicated business structure as the production, the distribution, and the sale of power, the genius, the energy, the initiative, and the rewards of private enterprise are needed. Without the constant effort to earn dividends, it is hardly conceivable that private or public enterprise would have made the advances in scientific and efficient power production and distribution which have enabled this industry to compete with, and supplant all other forms of light and many forms of power. This factor of efficient management must be maintained. Only in private initiative and enterprise can it be found, and only through the rewards and discipline of private enterprise can it be attracted and made effective. Yet, on the other hand, there is the claim of exploitation by the public; and the demand by the public that government enter the power business in order to reduce taxes. Behind both these viewpoints lies the latent thought that under public ownership the public will be protected. Many seem to prefer to hazard technical advance and to risk almost certain minimum betterment or even loss in favor of this assumption.

It would not take much time to make an assay of the good points of both private and public ownership, to see if the best of each could not be salvaged for the pooling of these common benefits in a new, mutually profitable, and useful line of procedure. Private initiative does not operate at its most effective level under full public control, and the public does not feel free from exploitation if it does not have ownership. It is therefore suggested that for local operation both these needs be considered as a new basis of procedure; that private enterprise be looked to for management; and that public ownership carry participating managerial functions as to rate structures and the scope of operations, with both private enterprise and the people sharing in ownership and in resulting profits.

Concretely, I recommend the development of what might be called state mutual power companies, on a state-limited basis. To pool into aggregates of useful capital the now marginal benefits of increasingly small rate reductions to the individual consumer, the investment now held by private ownership would gradually be amortized through payments from existing rate structures maintained at promotionally tenable levels over long future periods. As this amortization of present investment progressed, the resulting percentage of net revenue could be diverted as new income to the people of the state. The final objective would be to keep private management, maintaining its interest, willingness, and effectiveness by a controlling percentage of ownership, the state to have ample voice in operation and rates and to hold the remaining percentage of ownership. Net profits, above investment amortization needs, would be divided equally between the state and private ownership, right from the start. Thus could be combined public ownership and private management, with a division of profits, for local situations. While on private enterprise and on productive business effort have rested the very foundations of the supporting revenue of our present form of government, a large section of the population, directed by sane and thoughtful people, apparently is convinced that only through the arm of government can desired results be safely achieved. An opposing large section of the population seems to think that only through the arm of private enterprise can progress be ensured. Yet these two arms are of the same people, and they are not different in any respect except as to the method of their working.

AN UNBIASED COMMISSION NEEDED

This now headless body of the people with its two powerful outreaching arms, flailing each other in hopeless opposition, needs some intelligence to guide and to direct these efforts into cooperative, constructive, integrated activity for the good of the whole body, the mass of the people. It would seem a sane and a proper thing if some judicial group, or unbiased authority, including the representatives of both government activities and of private industry, were formed for the purpose of drawing from each the best, and of welding into a new plan the details of an economic procedure based on the common interest of all the people. The engineers of the Nation are versed in hard fact, trained to a detached, judicious weighing of pertinent and tenable influences, and conceded to have an insight and integrity of viewpoint above pandering to other than sound facts and influences. It would seem that they might very well be large contributors to such a judicial effort designed for the hearing, for the searching out, and for the determining of facts to chart a course for the operation of the business of the Nation in a way that would not sacrifice honest investment and enterprise, would protect the public, but which would be beyond vitiation by political influence.

CONCLUSION

It seems reasonable to conclude that the equities both of the individual and of all the people can best be maintained by the exclusion of government from ownership in revenue-producing activities except on the basis of mandatorially self-supporting rate structures; or, on a cooperative basis of interim subsidy and mutual effort in support of non-competitive private enterprise, in which the public welfare could be furthered more rapidly than private business can afford, to achieve a quicker and wider economic and social betterment. In such an equitable theory of governmental participation may be found some of the coordinates for a chart of progress for any people.

Let government hesitate on the threshold of every new endeavor blazoned for the benefit of the few to mark and measure the cost to the many, and before undertaking to destroy what exists, let it explore the possibilities of salvaging what is good in the old, to achieve the irreducible total of real costs to all. This could be the basis of a policy for any government.

Lastly, until there is final proof of the failure of all private initiative—as opposed to the controllable abuses of the few; and until the last recourse of ingenuity proves its utter inability to respond to the common welfare, let the survival of individual freedom, of initiative, and of enterprise be our directional compass.

Legality of a Self-Supporting Rate Base

By James P. Gifford
Attorney-at-Law; Assistant Professor of Law and Assistant to the Dean,
Columbia Law School, New York, N.Y.

How far is it possible to retain the very real advantages of private ownership and yet ensure that society as a whole will not be plunged into recurrent periods of depression and of great prosperity, either of which are extremely disorganizing to the orderly movement of life? These are matters of concern in every country in the world to a greater or less degree, and they are matters regarding which there are wide and sharp differences of opinion. Social life has had its static periods and its dynamic periods, and who can doubt that today society is in one of those great dynamic upheavals in which there seem to be present, factors never present before?

Since electric power is necessary to provide a large part of the things needed for worth-while living, there is no inherent objection to the entire community's saying, "We insist that all means of producing power belong to us and be under our full control." Whether it is wise to yield to such a demand is of course debatable. But there is nothing inherently unjust, unethical, or illegal in such an attitude any more than there would be in insisting that the land, which is also essential to life, belong to and be controlled by the entire community.

One of the wisest of our citizens, former Justice Oliver Wendell Holmes, once said that the law does not exist to enforce Herbert Spencer's theory of social statics. Law, as well as society, is dynamic. It exists, or should exist, but for one purpose—to enforce in an orderly and consistent fashion the rules which an entire social group has laid down as expressing its beliefs as to how the welfare of the whole group can be best promoted. As a matter of fact and of necessity, the expression, interpretation, and application of these rules always lag behind the developing ideals and ideas of the community. This is perhaps desirable. Such lag unquestionably puts a brake on that very natural human tendency to rush from the evil that is known into the evil that is unknown. In any event, the lag exists. But this inevitable lag must not be interpreted as expressing a desire of the community that the law shall remain fixed, static, or immutable.

In connection with this subject of government ownership, a pertinent question is: What is the possibility of obtaining from a court a mandatory requirement that governmentally owned and operated services should have a rate structure providing a self-supporting revenue basis? Speaking of the existing legal system, the answer is simply this: There is no such possibility. Once the Government or a municipality is given the proper legislative authority to engage in a public service enterprise, no court of law or equity would, in the absence of evident fraud, interfere with the running of that enterprise even if it resulted, as it does in many cases, in a partial subsidy to certain consumers.

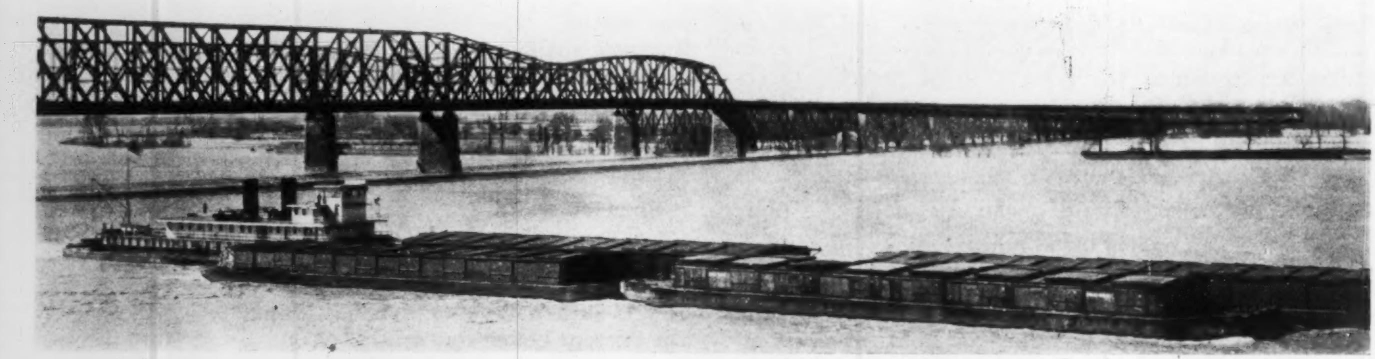
The exact case arose in Ohio as early as 1914, as detailed in Butler v. Karb, 16 Ohio Nisi Prius Reports, New Series, page 593. There a taxpayer raised this very question and sought to prevent the mayor and other city officials from running the city electric light plant at a loss and from selling current to private persons below cost. The court bluntly held that no cause of action was stated. The reasoning was as follows. The city is given authority to establish, maintain, and operate a plant to furnish the municipality and its inhabitants with light, power, and heat (to paraphrase the statute). Possessing that power, it can obviously use it to light the streets and for other city purposes and sell it to private consumers. In furnishing it to consumers, it must compete with other persons or corporations in the same business. The only restraint on private plants against selling below cost is the necessity of making a profit. If they do not they will go out of business. The city is in a more fortunate position. It can distribute the current below cost and meet out of taxes the interest on the bonds issued to erect the plant. Any other position would be absurd. If the city uses most of the current for lighting the streets, must the private consumers be charged exorbitant rates to make up the loss? That would be nonsensical and would make it impossible for the city to meet any of the expenses of the plant by attempting to sell its surplus power. Therefore the city can sell the power at any price it chooses.

The court then pointed out the intolerable situation which would result if the judges were constantly interfering with the discretion of the executive officials in the management of the plant. It intimated that it might interfere if there were gross mismanagement amounting to fraud, but not otherwise. The taxpayer was requesting the court to exercise an "equitable" power. The court said it had no such power.

The use of the world "equitable" requires explanation, for it is used in a technical sense. The Anglo-American jurist's concept of "equity" is always confusing to laymen and frequently to lawyers. Laymen habitually think of equity as synonymous with justice or fairness. There is some historical justification for that concept. The King's courts, as originally established, had a rather limited jurisdiction, which tended to become crystallized and fixed. Quite early, situations arose in which the law courts found themselves helpless. For example, Jones promised to sell land to Smith. Then Jones refused to convey. All the law courts could do was to give Smith damages. But Smith wanted the land. So he appealed to the King as the fountain head of all justice to do equity, or justice. The King referred the matter to the keeper of his conscience, the Chancellor. The Chancellor decided that Smith should have the land and decreed that unless Jones conveyed the land, the Chancellor would put Jones in jail. And Jones usually conveyed the land. This of course is the well-known action of specific performance and is one of the many wrongs which can be righted by equity. In this technical sense equity is really a branch of the sovereign's power of administering law in its broadest meaning.

It was inevitable that in the course of time the situations in which the Chancellors would act should become fixed and crystallized. From the ways in which they acted there grew up the rules of equity, taken over by this country at the time it severed relations with England. And although the equitable powers of a court are today more flexible and less well defined than the statutory or common law powers, nevertheless the equitable powers of a court are limited. A careful search of the books reveals nothing to indicate that any court today or tomorrow would exercise a mandatory power of the nature suggested. I understand that the Supreme Court of the United States has quite recently decided that for a municipal plant to sell its power at a rate below that at which a competing private plant can afford to sell, does not deny the private plant equal protection of the law.

So as a lawyer I must answer "No" to this question as to whether a self-supporting rate base can be made mandatory for governmentally owned and operated services. From the viewpoint of the social philosopher—and today we are all by necessity social philosophers—it is at least arguable that refusal of the courts to interfere is socially desirable. There is nothing inherently unwise, unjust, or illegal in granting a partial subsidy to the users of the services of a revenue-producing enterprise. Witness the post office, the shipping industry, the airplane industry, the publishing industry, and all advertisers who use the advantageous postal rates. Electric power is, and will increasingly become a public necessity, and there is much to be said in favor of giving the Government the fullest measure of control over its production and distribution.



TYPICAL RIVER TOW ON THE MISSISSIPPI RIVER AT MEMPHIS

Operations of Inland Waterways Corporation

By CHARLES KELLER

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
BYLLESBY ENGINEERING AND MANAGEMENT CORPORATION, CHICAGO, ILL.

SO closely does the history of navigation on the Mississippi River parallel that of inland river transportation of every form in the United States that it may be regarded as typical. Both for this reason and because the operations of the Inland Waterways Corporation on the Mississippi have been more successful than in other places, it is in no way unfair to the Corporation to measure its performance by its activities on that river.

It was in the fifties that the first railroads approached and crossed the Mississippi River. Up to 1850 there were in the United States only 9,000 miles of railroad, but by the time the Civil War broke out there were 30,000 miles. The war caused a pause in railroad construction, but with its termination construction once more went ahead very actively. By 1910 there were 240,000 miles of track in use. Since that date, as can be seen in Fig. 1, the rate of railroad construction has dropped off sensibly.

It was during the seventies that the railroads came to parallel the Mississippi River. Between 1880 and 1890, approximately, through lines were established on both its banks. Steamboat traffic on the river then began to fall off. In 1894 the traffic on the Upper Mississippi River consisted mainly of lumber in rafts, both the lumber and the towboats belonging mostly to the lumber companies who were doing business on the banks of the river. Besides this lumber movement, the only means of river transportation then existing on the upper river was a single through packet line, which made infrequent sailings during the fair part of the year between the Twin Cities and St. Louis, and a number of small and insignificant traffic lines operating locally between small ports.

Below St. Louis there was a barge line that hauled grain from that city to New Orleans and did quite an active business; there were a number of small packet lines carrying passengers and freight between way points; there was some through coal business originating on the Ohio River and destined for Memphis and points below; and also there was a good deal of cotton moving from Memphis to New Orleans.

In addition to the development of effective railroad competition, another blow to the river traffic was the great storm of 1897. This storm served to accelerate the downfall of the river traffic. In the storm practically every boat in the harbor of St. Louis was destroyed, and there were a great many of them there. Few of them were rebuilt, a fact which shows how little real vitality there then remained in the river traffic. By the time of the World War, traffic on the Mississippi, both above and below St. Louis, was practically extinct.

Although the river route is longer and movement on it is usually slower than on the railroad, other important influences conspired to bring about this condition. The channel could not always be relied upon as to location, and it was subject to changes that influenced the carrying capacity of the boats and the regularity of their schedules. The concerns engaged in transportation on the river did not command the confidence of the influential business community, and so they lacked the support of adequate capital. Finally, this form of transportation was unable to secure the cooperation of the railroads in the making of joint rates, and the railroads were permitted to charge relatively low rates between river points and thus to accentuate the disadvantages against which the water carriers labored.

The efforts of the friends of river traffic were confined mainly to river-improvement associations and their meetings, to lobbying in Congress, and to general public agitation. They were unsystematized, so that although river transportation seemed to have strong support it made no advances until this country entered the war in Europe.

A group of influential men from all over the central part of the country were gathered about William M. Black, M. Am. Soc. C.E., at that time Chief of Engineers of the Army. He and they labored long and hard with Secretary William G. McAdoo, then head of the Railroad Administration, in the effort to convince him that the congested transportation situation of the country could be very much alleviated by using the rivers to their full capacity.

One of their principal arguments was that hitherto those channels had not been properly employed because private enterprise either was lacking or was deemed incompetent or unwilling. What was really needed, they said, was a demonstration on a scale sufficient to convince private enterprises that those channels could be effectively used. As soon as such a demonstration had been conclusively made, it was proposed by General Black and his associates that the facilities provided should be transferred to private hands.

Finally Secretary McAdoo yielded, and in September 1918 he authorized the expenditure of Government funds in the initiation of what was then called the Inland and Coastwise Waterways Service. About $7,000,000 was then allotted for the purchase or hire of existing facilities and for the construction of such new plant as was deemed to be necessary.

INLAND WATERWAYS CORPORATION FORMED

The Inland and Coastwise Waterways Service operated as an agency of the Railroad Administration until February 1920, when the service was transferred to the War Department. The War Department continued that operation under the act referred to until early in June of 1924, when Congress passed an act creating the Inland Waterways Corporation of the United States with a capital of five million dollars. The purpose of the Corporation was to carry on the operations that had hitherto been conducted by the Inland and Intercoastal Waterways Service of the War Department under General Ashburn, who was father of this new legislation and who became the active head of the Inland Waterways Corporation. The new legislation removed the difficulties inherent in the operation of a Government bureau functioning under annual appropriations, and thus the Corporation was afforded an opportunity to do business as a private agency would.

Every effort was made to develop ample facilities for successful operation on the inland channels. The Secretary of War originally, and later the Corporation, were authorized to make any kind of investigations they pleased to determine the most efficient form of carrier. They were also authorized to assist municipalities in the design of modern and efficient terminals. The act creating the Corporation went further and authorized it to loan, without interest, to municipalities desiring to establish terminals, the funds necessary for their construction.

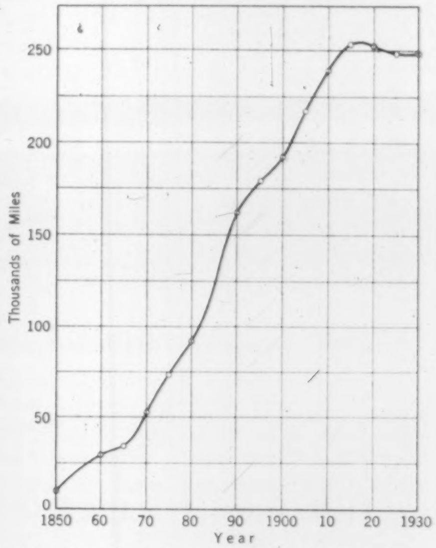


Fig. 1. Increases in Mileage of the Railroads of the United States Since 1850

The Inland Waterways Corporation has increased the operations of the Inland and Coastwise Waterways Service. It operates not only on the Warrior and the Lower Mississippi rivers, but since 1927 has extended its activities on the latter to the Twin Cities, and in 1930 it began operation on the Illinois River up to Peoria, and work is under way to make Chicago the terminus of this division of the Corporation.

According to the most recent annual report of the Corporation, in 1932 the traffic on the lower river, that is, between St. Louis and New Orleans, was 1,292,000 tons, made up of a wide variety of commodities, such as wheat, corn, sugar, bags and bagging, cotton, cotton burlap, and cotton piece-goods; steel bars, sheets, and structural shapes; tobacco, coffee, canned goods, soap, and soap powder. Many other high-class commodities were also represented in significant volumes. Thus, contrary to general belief, the business does not consist of cheap, low-grade freight like coal but of the very commodities that form the life blood of the railroads. Apparently the shippers of such goods believe that it is to their advantage to use the facilities of the Corporation. On the Upper Mississippi, that is, between the Twin Cities and St. Louis, the 1932 traffic was relatively insignificant in volume, partly because the channel in that section is less satisfactory than below St. Louis. The actual tonnage was 104,000 tons, 35 per cent more than had been carried in the preceding year, so that in any event the volume of traffic seems to be increasing

In summing up the accomplishments of the Corporation and its predecessor since 1918, it is only fair to state that a great deal has been done in the face of difficulties. It and its predecessor, the Coastwise and Inland Waterways Service, were virtually pioneers in the effort to supply a modern common-carrier service, with regular and frequent sailings. To do that they had to develop efficient carriers and towboats and to learn how to operate them satisfactorily on the various channels. That was a slow and costly process during which many mistakes were naturally made. In addition, proper terminals had to be devised and built at the principal points and, most important of all, the railroads had to be persuaded to establish joint rates. A considerable measure of success has been attained on the Lower Mississippi; and while the results elsewhere are not as good, there is every reason to believe that with the completion of the 9-ft channel to Chicago and to the Twin Cities, improvement will also be shown in the traffic on the Illinois and the Upper Mississippi.

EIGHT BARGES LOADED WITH 16,000 TONS OF FREIGHT
This Would Require 10 Railroad Trains of 80 Cars Each

There has been considerable controversy with respect to the propriety and success of this venture in the field of river transportation. The case has not been fairly stated either by those in favor or those opposed to it. The facts appear to be about as follows. For many years the United States had been spending money to improve the channels of our inland waterways, but in spite of expenditures on an increasing scale, traffic had declined, in some cases until it was practically nonexistent, and private capital had found it, generally speaking, impossible or undesirable to engage in transportation on the waterways. This inability or disinclination seemed partly due to the belief that such operation could not be conducted profitably in competition with other forms of transportation, and partly to the knowledge that previous attempts had failed. But most of all it was due to the fact that no single group had sufficient resources to justify it in attempting to find the best type of equipment and to operate it with economy and regularity.

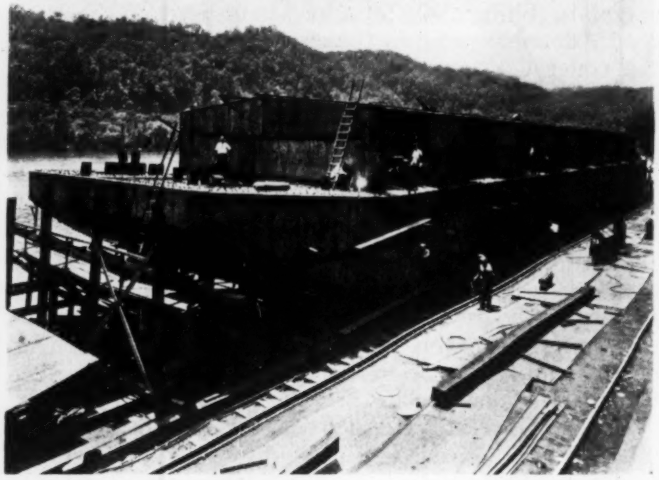
It thus became obvious that the only hope of promoting this form of transportation lay in an effort of the National Government to prove that river transportation could be conducted with profit at rates that would attract traffic.

It was the intention of those influential in procuring the support of the Railroad Administration that the demonstration should be made on the then existing channels, and should include the erection of efficient terminal facilities. They recognized that the acquisition of the best floating and terminal equipment for the waterways would be a gradual process and that considerable time must elapse before tenable conclusions could be drawn and made known. It was also their intention that private enterprise should be induced or permitted to take over the operation of these facilities as soon as there was reasonable proof that profits could be earned or that, if this large-scale venture proved to be a failure, operation should be suspended and Federal expenditures on useless inland waterways discontinued.

If the experiment is still in progress as originally conceived, a standard for testing its success should be formulated and published. This has never been done.

BIENVILLE STREET WHARF, NEW ORLEANS

In judging the success of the experiment, three principles seem applicable. The first principle is that, with efficient floating plant and terminals, sufficient funds, a competent personnel, and proper management, it should be shown to be commercially possible to operate on the channels contemplated by the authorized projects and to earn a reasonable return without expenditures for improvement and maintenance by the Government greater than those contemplated when the experiment was begun. It is beside the mark to prove that such operation is possible on extravagantly costly channels.



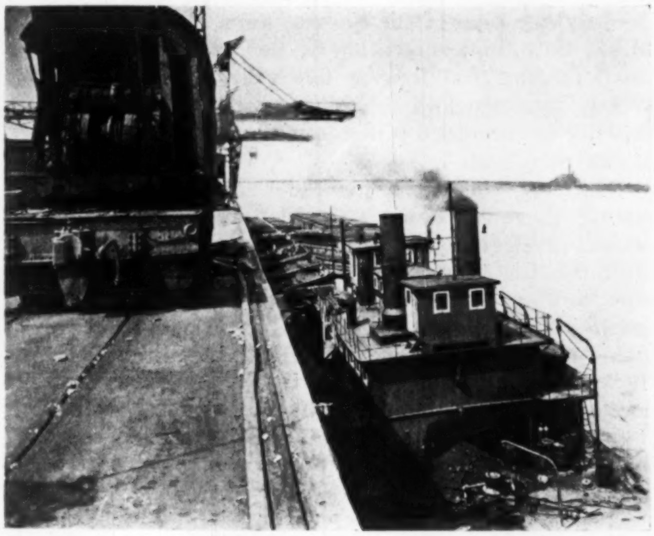
STEEL BARGE FOR THE INLAND WATERWAYS CORPORATION
Being Built by the Midland Barge Company, Midland, Pa.

The next principle is that, at a cost to the shipper sufficiently low to justify the making and the maintenance of the channels, boat lines must give as good service as other forms of transportation and yet earn a fair return on the invested capital. The final principle is that this fair return should be earned precisely as though it were the private operation toward which the entire experiment was aimed. In other words, the earnings of the Corporation should be sufficient to cover operating expenses, property and income taxes, insurance and depreciation and, in addition, a reasonable return on the capital employed. The 1932 balance sheet of the Corporation shows an investment of nearly $23,500,000 in floating plant and other necessary property, against which it has created a reserve for depreciation of $3,500,000.

At the end of 1932, New Orleans, Vicksburg, Memphis, and Helena, all of which had received loans for the construction of terminals aggregating about $900,000, still owed the Corporation $642,000. In its 1932 statement, it does not give the income of the separate divisions under which it operates. Its total net income was stated to be $470,000 and this was a gain of $200,000 over 1931.

INSURANCE AND DEPRECIATION

Apparently the Corporation makes due provision for insurance. Also, in the absence of evidence to the contrary, the allowance for depreciation hitherto made by it may be accepted as equitable. However, it does not appear that it has ever considered suitable allowances for taxes on its property, for income taxes, and for a return on the capital employed. If it is assumed that taxes on the physical property of a private owner would be 2 per cent and that all capital should net an income of at least 6 per cent, then the Corporation, based on the figures of its 1932 balance sheet, should have shown an ability to earn approximately $1,900,000 over and above operating expenses, depreciation, insurance, and income taxes during 1932.



LOADING MISSISSIPPI RIVER BARGES AT THE ST. LOUIS TERMINAL, MISSOURI

A fair measure of the past success of the Corporation in conforming to the principles enunciated by Mr. McDonald is the statement that its actual earnings, as detailed in 1932, were $470,000 and that it paid no property or income taxes. During the four preceding years, when its capital did not differ greatly from the 1932 total, its earnings did not exceed $327,000 in any year, and in one year there was a deficit of $109,000. It is clear from these figures that up to this time the Corporation has come far short of showing that such a venture can be commercially profitable.

Of all the operations carried on by the Corporation, those on the Lower Mississippi River have been the most successful. In that division the earnings in 1928 were $702,000; in 1929, $362,000. The reports for the three following years fail to give the earnings of the Lower Mississippi River division separately; but I have calculated that in 1930 they were $440,000; in 1931, $650,000; and in 1932, $800,000. The largest of these figures is far short of what should be earned in order to demonstrate that the operation of steamboats and barges even on the Lower Mississippi River would be a profitable thing for private enterprise to undertake.

TRANSFERRING FREIGHT FROM CARS TO BARGES, IN EAST ST. LOUIS
Both Hand-Operated and Mechanical Equipment Used to Facilitate Barge Loading in St. Louis

EXPERIMENT SHOULD NOT BE CONTINUED INDEFINITELY

Against this shortcoming in profits, it may reasonably be urged that the Corporation has been and still is in a period of development and extension, that much of its early expenditure was on unsuitable plant and for purposes not connected with its present operations, and that it would be unfair to expect it to produce the results here demanded until its business had become established. Yet there ought to be some limits to the extent and duration of the experiment initiated in 1919. A liberal territorial limit would include the entire Mississippi, the inland waterway to Chicago, and the Warrior division. A reasonable time limit might be set at 1938, when the 9-ft channels to the Twin Cities and to Chicago will have been completed and in use for a fair length of time. Unless some such limits are set, the experiment may be extended first to Kansas City, then to Omaha, then to the other tributaries of the Mississippi, and so interminably, and there will always be alleged justification for inadequate earnings and for further experiment.

With the completion of the 9-ft channel on the Upper Mississippi and the Illinois, the Corporation will have access to a rich and populous territory, and it should have adequate personnel and plant to serve a diversified traffic. If it cannot demonstrate the entire practicability of its operations under these circumstances, further extension would be useless. It would be worse than futile for the United States to expend large additional amounts on channel improvements and on plant to enable service to be extended to streams less promising than the Illinois and the Mississippi and to regions where the only, or the principal industry is agriculture.

Underground Corrosion of Ferrous Pipe

Abstract of Paper Read Before Sanitary Engineering Division, January 18, 1934

By K. H. Logan

Chief, Underground Corrosion Section, Bureau of Standards, Washington, D.C.

UNDERGROUND corrosion of pipes is shown to be of economic importance by the fact that associations of pipe owners and pipe owning corporations are spending considerable sums for the study of its problems. Underground pipes in the United States have been estimated to have a length of 450,000 miles and a value of nearly six billion dollars. The annual loss due to underground corrosion of pipe lines in the oil industry alone has been estimated at $25,000,000. This sum probably should be multiplied by at least three to represent the losses on all underground pipe in the country.

Soil corrosion is characterized by its uneven distribution and the fact that most ferrous pipe materials corrode at nearly the same rate. The character and seriousness of soil action have been found to vary with the soil condition to which the material is exposed. This variation is so great that it appears to be a much more important factor than the type of ferrous pipe material used. After a pipe has been exposed to the soil for several years the rate of corrosion is considerably less than that during the first period of exposure. The most interesting characteristic of underground corrosion is the irregular or spotty nature of the attack. The actual loss of material is usually so small that it would not be of importance if it were uniformly distributed over the pipe surface.

CORROSION DUE TO IMPURITIES NOT GENERAL

When the electrolytic theory of corrosion became generally accepted, the first explanation offered for the formation of pits in a pipe surface was that there were impurities or segregations in the pipe material. This conclusion was supported by the fact that where impurities were known to exist, differences in potential between the impurities and the metal could be measured. Other differences of potential were observed when different metals or two varieties of the same metal were in contact. There can be little doubt that some corrosion results as suggested. However, when materials are buried in soil, and under some other conditions as well, other causes of corrosion are more important.

In the course of an investigation of the relation to corrosion of electric currents in pipe lines it was noted by E. R. Shepard in his article, "Pipe Line Currents and Soil Resistance as Indicators of Local Corrosive Soil Areas," in the U. S. Bureau of Standards' *Journal of Research*, Vol. 6, page 683 (April 1931), that the soils in which corrosion was most active were lower in electrical resistance than adjacent, less corrosive soils. The lower resistance could be accounted for by higher percentages of water or soluble salts.

The importance of oxygen concentration was first realized in 1916 by J. Aston, whose paper on the subject was published in the *Transactions* of the American Electrochemical Society, Vol. 29 (1916), page 449, although the creation of electric currents by variations in oxygen concentration was observed at a much earlier date.

As a result of investigations at the U. S. Bureau of Standards, based on the principles of underground corrosion here enumerated, several practical methods have developed whereby the operator can determine where the most serious corrosion in the line is occurring. The principles and limitations of the older and more frequently used resistivity test have been described by Shepard in his previously mentioned paper. This method has been tried out in widely separated sections of the country under several soil conditions. In all cases it has located some of the corrosive areas.

Although probably less than 10 per cent of the underground piping of the country is in corrosive soil, it is likely that any extensive corrosion survey will locate one or more places where a reduction of the possible corrosive effects of the soil seems desirable. The engineer is then faced with the choice of a method for maintaining his line in one or more localities. The preferable method will depend on local conditions. Since corrosion underground has been attributed to variations in the supply of oxygen at different points along the line, an obvious way of preventing it is to secure uniform conditions with respect to oxygen. Unfortunately, the field application of this principle is very limited. Deep burial of the pipe and uniform tamping of the backfill are helpful.

Among the methods suggested for reducing corrosion losses are the use of copper and copper alloy pipe, which corrode less rapidly than ferrous materials; increasing the thickness of the pipe wall; and the use of protective coatings. It has been determined from tests on $^{3}/_{4}$-in. steel service pipe in the Susquehanna clay at Meridian, Miss., that the penetration of the pipe by corrosion is rapid for the first four or five years, after which it is greatly retarded and continues probably at a declining rate due to the added protection afforded by the products of the corrosion.

Whatever the cause for the decline in the rate of pitting, there can be little doubt that in many soils this decline is so great that corrosion penetrates but slowly after the first few years. In such soils the failure of pipe lines could be minimized by providing a pipe wall sufficient to withstand the initial attack and the subsequent slow penetration. In many instances the wall thickness required for a very long life before penetration does not appear to be prohibitive. It may be better engineering to provide extra wall thickness than to invest in corrosion-resistant materials or protective coatings.

The purchaser of a pipe coating should consider not only whether its fundamental properties are satisfactory but also the probability of getting it in the ground in a satisfactory condition. If the size or weight of the pipe section is so great that it cannot be handled commercially without injury to the coating, the advisability of the coating is at least debatable.

NEED FOR CORROSION RESEARCH

A definite plan of study has been mapped out by the students of corrosion, and definite progress has been made. The continuation of the work for a few more years will yield results of commercial value.

New York's West Side Elevated Highway

Structure Not Yet Completed Is Already Relieving Traffic in Congested Manhattan

By Benjamin Schwerin
Associate Member American Society of Civil Engineers
Assistant Engineer, Department of Public Works, Manhattan, New York, N.Y.

An average of more than a half million vehicles daily cross the bodies of water surrounding Manhattan Island, New York. To relieve the resulting congestion, which often taxes the resources of the Metropolitan Traffic Squad, an elevated highway is now under construction along the west margin of the island between Canal Street on the south and Riverside Drive at 72d Street on the north. Completed parts of this $15,500,000 viaduct are now open to traffic and are attracting a million vehicles per month. The effect of the structure on north- and southbound traffic is the subject of this article, an abstract of the paper presented by Mr. Schwerin on January 18, 1934, before the Highway Division at the Annual Meeting of the Society in New York.

SOUTH of 59th Street, in the Borough of Manhattan, New York, is found an excessive concentration of business and industry and the greatest development of skyscrapers as to number and size in the world, resulting in an overcrowding of vehicles on the streets. The West Side Elevated Highway, along the Hudson River from Canal Street to West 72d Street, at present under construction and partially completed, was designed to provide a by-pass for through vehicular traffic to relieve the congestion which had long existed on the avenues and streets of the area. The cost of such congestion in Manhattan has been conservatively estimated at $500,000 per day.

In the past ten years a great many meritorious improvements have been carried out by the city and borough authorities, which have had for their purpose the relief of vehicular congestion through regulation, physical improvement, and increased capacity in existing streets. Among these should be mentioned the widening of streets and roadways; removal of street railway tracks and elevated railroad columns, where possible; increasing of curb corner radii; extension of north and south arteries, notably Park Avenue, Sixth Avenue, and First Avenue; separation of important grade crossings; improvement of pavements to attract traffic to hitherto slightly used thoroughfares; and regulation of movement by signals, restrictions as to direction, parking limitations, and other means.

These heroic measures, involving the expenditure of large sums of money, have served admirably in their purpose but have been fundamentally inadequate to cope with a situation that has been rapidly becoming more acute in mid-Manhattan because of a normal increase in vehicular traffic and the completion of additional avenues of entrance into the area.

By freeing Marginal Street, along the Hudson River waterfront, of the through light vehicular traffic which now interferes with the efficient conduct of the business of the port, further very urgent relief is afforded. In addition, the columns of the overhead structure establish definite surface lanes for trucking, three lanes under each half of the viaduct, and in this way contribute in a large degree toward a freer and more orderly movement of traffic along the waterfront. There is a heavy concentration of light vehicular traffic at the transatlantic steamship piers at times of sailings and arrivals, when long lines of standing vehicles paralyze traffic movement on the street in the immediate vicinity of the piers. This condition has been recognized, and the highway has been designed to connect with the second-story level of the new transatlantic piers now under construction between West 48th Street and West 54th Street. Reservoir space will be provided on the structure for these vehicles.

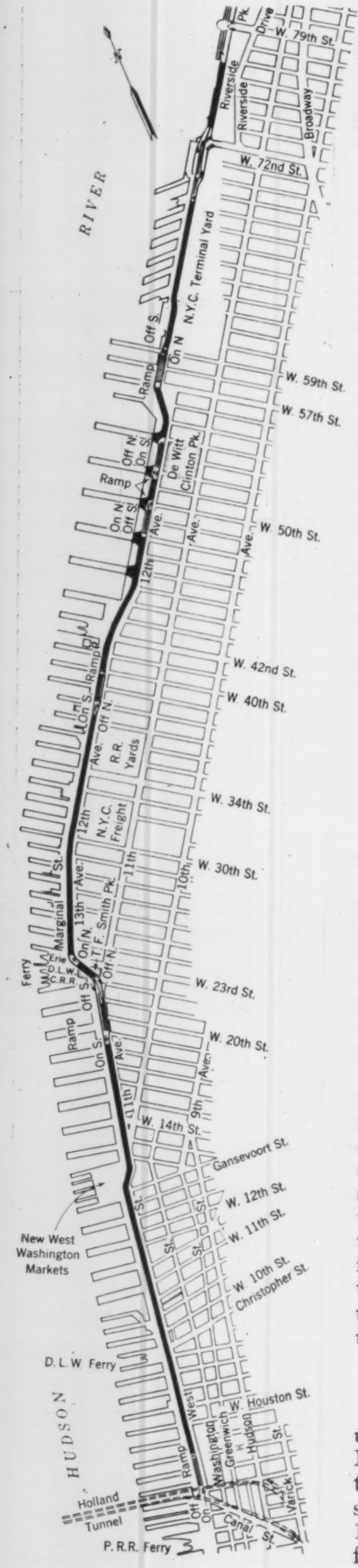
RECENT COUNT SHOWS HEAVY USE

Traffic counts taken by the Police Department on the elevated highway between Canal Street and West 38th Street, which is about one-half of the projected route of the highway, between 7 a.m. and 7 p.m., on October 16, 1933, showed a total of 24,000 vehicles, or an average of 2,000 per hr. The heaviest southbound movement occurred between 9 a.m. and 10 a.m., and amounted to 1,400 vehicles, whereas the heaviest northbound movement occurred between 5 p.m. and 6 p.m., and amounted to 1,672 vehicles. It is estimated that more than a million vehicles utilize the elevated highway monthly.

Between 38th Street and 59th Street there is a gap in the highway which remains to be filled. Early construction of the section from 38th to 46th streets seems assured, since bids for that part were taken on November 3, 1933, and construction contract awarded. The elevated highway between Canal Street and West 72d Street represents the initial step in the program to build a marginal vehicular roadway along the Hudson River for the entire length of Manhattan and crossing the Harlem River into the Bronx, which project, exclusive of the part from Canal Street to 59th Street, has been incorporated in the New York Central West Side Improvement plans, which were adopted in 1929 and are now in the process of execution.

WATERFRONT LOCATION CHOSEN

It soon became apparent to all the agencies which studied this situation—its causes, effects, and remedies—that it would be necessary to create a new artery to enable through traffic to by-pass the congested area. Such a highway should be elevated above the existing street surface to avoid crossings at grade and permit uninterrupted movement. Studies for such a roadway through the center of the island, between two main north and south arteries, on a right of way to be acquired through private property, revealed costs highly prohibitive ($25,000,000 per mile for a 100-ft street); and so attention was directed to the West Side waterfront. The combined waterfront street and marginal way of unusual width was well adapted to an improvement of this character. The construction of an elevated highway there would not seriously detract from the usefulness of the property required, which would be reserved for commercial purposes in connection with port activities; nor would any appreciable damage result to abutting property in private ownership. Furthermore, the removal


RIVER
Pk.
Drive
W. 79th St.
Riverside
Riverside
Broadway
W. 72nd St.
N.Y.C. Terminal Yard
Off S.
On N
Ramp
W. 59th St.
W. 57th St.
Off N.
On S.
De Witt
Clinton Pk.
Ramp
On N.
Off S.
Ave.
Ave.
Ave.
W. 50th St.
12th
Ramp
On S.
Off N.
Ave.
R.R.
Yards
W. 42nd St.
W. 40th St.
W. 34th St.
12th
N.Y.C.
Freight
11th
10th
W. 30th St.
St.
Marginal
13th
Ave.
On N.
T. F. Smith Pk.
Off N.
Ferry
Erie
D.L.W.
C.R.R.
Off S.
W. 23rd St.
Ramp
On S.
Ave.
W. 20th St.
Ave.
11th
9th
W. 14th St.
Gansevoort St.
W. 12th St.
W. 11th St.
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St.
New West
Washington
Markets
W. 10th St.
Christopher St.
D. L. W. Ferry
W. Houston St.
HUDSON
Ramp
West
Washington
Greenwich
Hudson
St.
Varick
Holland
Tunnel
Off
On
Canal
St.
P.R.R. Ferry

FIG. 1. LOCATION OF WEST SIDE ELEVATED HIGHWAY ALONG WEST SIDE OF MANHATTAN, NEW YORK, N.Y.

of a considerable volume of traffic to the elevated highway would afford relief to the heavy trucking traffic which must continue to use the surface street and so would more than compensate for the relatively slight encroachment of the proposed structure on the marginal area. This was the only location which did not involve the purchase of private property for a right of way at an exceedingly high cost, and which would cause no serious damage to the abutting property.

In Fig. 1 are shown the layout and location of the elevated express highway in relation to the street system of Manhattan. At its northerly end it connects with Riverside Drive, thereby providing a direct and satisfactory route to the south for the traffic from that highway, which previously was dispersed with considerable delays through other arteries reached by devious routes. The 60th Street terminal of the New York Central Railroad Company, extending along the waterfront from West 59th Street to West 72d Street, will no longer block the free movement of southbound traffic on Riverside Drive. The southerly terminus of the express route is at Canal Street, which is a broad, diagonal thoroughfare leading directly to the Holland Tunnel and the Manhattan Bridge.

Ramps for access to and departure from the highway have been located so as best to serve the traffic needs of business and other activities in these areas. They are at Canal Street, West 23d Street, West 38th Street, West 46th Street, West 52d Street, and West 57th Street. Between Canal Street and West 72d Street the length of the highway is about $4^1/_4$ miles. The estimated cost of the completed structure is $15,600,000, of which $12,500,000 has already been expended. The construction of new steamship piers, the necessity of acquiring inshore areas for a relocated Marginal Street and way; the physical improvement of this street, as well as the financial condition of the city, account for the delay in the prosecution of this work, the early completion of which is sorely needed for the relief of traffic congestion.

The structure carries two 30-ft roadways, physically separated to prevent interference between traffic moving in opposite directions. A conservative estimate of the maximum hourly capacity for light passenger traffic operated at an average speed of 25 miles per hour is 6,000 vehicles. At this speed the time required to travel between Canal Street and West 72d Street is about 10 min. Such a trip on the surface under the most favorable conditions would require from two to three times as long, and in congested sections much longer.

TRAFFIC RELIEF VERY CONSIDERABLE

On a typical week day in 1928 the total volume of vehicular traffic entering and leaving Manhattan amounted to 450,000, whereas in 1932 this had risen to about 511,000—distributed as shown in Table I and Fig. 1—an increase of $13^1/_2$ per cent for the four-year period. For the four-year period 1924–1928, this traffic flow had showed an expansion of about 57 per cent. A comparison of these two percentages demonstrates to what an extent abnormal business conditions have affected traffic in the area. About

Looking Toward Terminus at 72d St.

Looking North from 23d St.

Ramp in T. F. Smith Park at 23d St.

Looking South at 14th St.

Looking North at Gansevoort St.

South Entrance Ramp at Canal St.

WEST SIDE ELEVATED HIGHWAY, NEW YORK, N.Y.

86 per cent of the 1928 total moved over the East River and Harlem River bridges in nearly equal amounts, and two-thirds of the traffic crossing the East River was concentrated on the three bridges connecting Brooklyn with lower Manhattan. The opening of the George Washington Bridge to traffic late in 1931 has undoubtedly affected the traffic flows across the Hudson River and caused a redistribution of that entering Manhattan from the north over the Harlem River bridges.

Table I. Summary of Traffic Flows Entering and Leaving Manhattan Island

Facility	Vehicles per 24 Hr	
	1928	1932
East River bridges and ferries	199,200	232,700
Harlem River bridges	189,600	198,200
Hudson River Tunnel, ferries, and bridge	58,100	77,500
Staten Island ferry	2,900	2,900
Total vehicles	449,800	511,300

From the traffic totals in Fig. 2 an idea may be gained of the concentration of vehicular traffic in the downtown Manhattan area where, because of an irregular street system, narrow streets, and insufficient north and south arteries, distribution is difficult and serious delays result. The traffic over the Queensboro Bridge, connecting 59th Street in Manhattan with the Borough of Queens, plays a large part in aggravating congestion in the midtown area. The combined flow of traffic on all the north and south avenues in mid-Manhattan, as determined by the Police Department, is approximately 27,000 vehicles per hour during the periods of greatest flow. The capacity of the new elevated highway, estimated at 6,000 vehicles per hour, is almost one quarter of the combined hourly flow of the 14 north and south traffic routes in the midtown area. Thus it will afford substantial local relief in the areas of the city most in need of it and will unquestionably induce a large volume of traffic to leave the central and highly congested avenues.

To arrive at any definite conclusion as to the effect of the elevated express highway on traffic flows in Manhattan, it is necessary to examine carefully the results of the survey of the origin and destination of traffic made for, and reported by Day and Zimmerman in 1929. From an analysis of the survey it is estimated that approximately one-third of the Holland Tunnel traffic would benefit by the use of the West Side Elevated Highway. Commercial traffic, to which this roadway is not now available, constitutes between 20 and 30 per cent of the total. The three lower East River bridges—Brooklyn, Manhattan, and Williamsburg—converge on the lower Manhattan area, their terminals being very closely spaced. It is estimated that they will contribute 17, 24, and 20 per cent of their traffic, respectively, to the highway.

Because of the necessity for the Queensboro Bridge traffic to traverse the island a distance of 1.7 miles and cross all the heavily laden north and south arteries, it is estimated that but 10 per cent of the Manhattan-bound traffic on this bridge will seek the highway.

The northerly terminus of the elevated highway at 72d Street leads directly into Riverside Drive, a through artery between this point and Dyckman Street, near the northerly end of Manhattan Island. No commercial traffic is permitted on the Drive. Suitable and adequate vehicular connections have been made between the Drive and the George Washington Bridge at West 178th Street. The elevated highway provides a practical extension of Riverside Drive to downtown Manhattan, making the total length of the route about 11 miles. Completion of the West Side Elevated Highway will probably cause a shift of the greater part of the load on Eleventh Avenue to it. In addition, the long-haul traffic on the west side of Manhattan between points in Manhattan and between the island and points north, will find it advantageous to use the highway.

The average hourly flow in 1929 on the West Side avenues, Seventh to Eleventh inclusive, was found to be practically 6,000 vehicles, of which 21 per cent was commercial. Of this total, 28 per cent traveled between Canal Street and 72d Street, and 43 per cent between 23d Street and 72d Street. It is reasonable to assume that practically all this traffic will find it convenient to use the new route. In addition, some part of the vehicular flow of 35,000 cars per day across the Hudson River ferries will undoubtedly seek the highway to avoid congestion elsewhere.

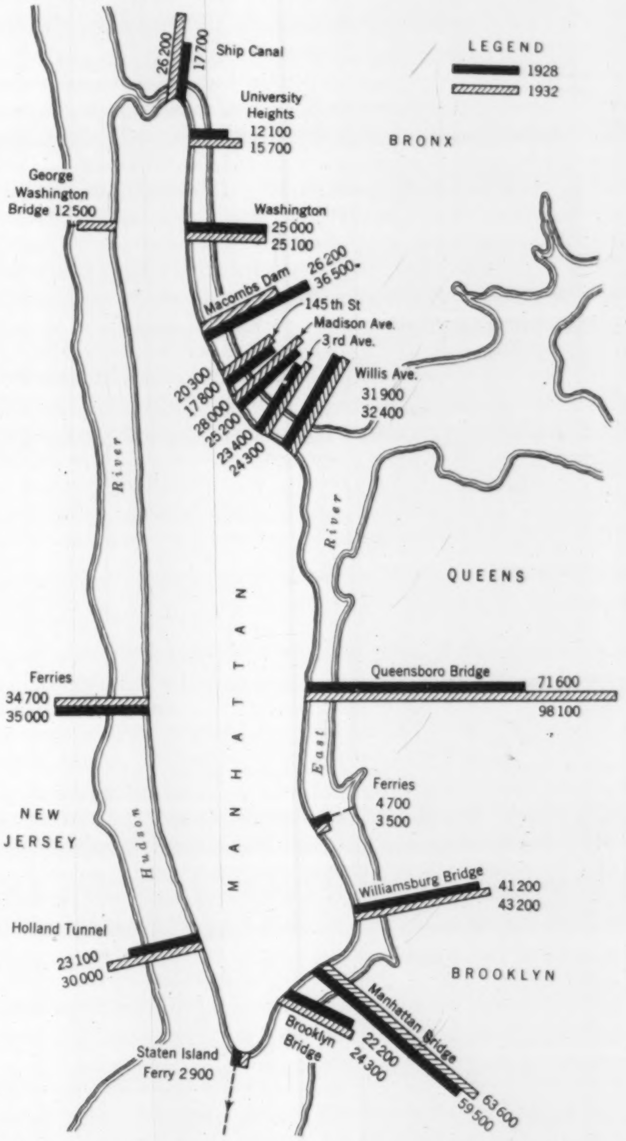


Fig. 2. Distribution of Week-Day Vehicular Traffic Entering and Leaving Manhattan, New York, in 1928 and 1932]

The design and construction of the elevated highway have been under the direction of Clifford M. Pinckney, M. Am. Soc. C.E., Chief Engineer. Grateful acknowledgment for assistance rendered in the collection of pertinent data is made to the Regional Plan Association, to the Port of New York Authority, and to the Police Department and other departments of the city government.

Power Versus Hand Labor

Committee on Construction Plant and Methods Reports to Construction Division on January 18, 1934, During the Annual Meeting of the Society

By A. E. Horst, M. Am. Soc. C.E., Chairman

Secretary-Treasurer and General Manager, Henry W. Horst Company, Philadelphia, Pa.

POWER equipment available for general use today owes its development to the fact that it is more efficient than hand labor. Strictly speaking, there is no work performed today by hand labor. Tools of one kind or another are used. If the object in starting an operation is to provide work on the site for the greatest number of men, of course the use of power equipment is at once abolished, and men may be given picks and shovels and wheelbarrows. But more men could be employed by replacing the picks with forks, the shovels with spoons, and the wheelbarrows with tin cups.

Today the country has an investment in the means of production, the capacity of which is far beyond the present ability of its citizens to consume. The philosophy behind the "New Deal" argues that the ability of the people to consume the products of industry must be increased, and that the only feasible way is to increase the purchasing power of the masses.

With great numbers out of work for a long time, and destitute of even the necessities of life, the CWA program has been inaugurated, placing several million people at work on the basis of a 30-hr week, at rates of pay ranging upward from 40 cents an hour. These people have been generally placed on projects where hand labor methods have been carried to great extremes. There is no doubt about the popularity for the moment of this policy, but an examination into the final results may show where, if possible, some improvement can be made.

Confining consideration to construction operations, take, for example, a grading project. Depending upon how far the hand labor theory is carried, it will be easily possible to employ twice as many men on such a project as would be employed by up-to-date methods using power equipment. Under such conditions it may easily cost 50 cents or more a cubic yard for excavation of material; whereas with modern machines this cost might be only 25 cents per cubic yard on the same kind of project. In the latter case, perhaps only half as many men will be used on the site of the work. It is important to note that where hand labor methods are followed, a job may cost $100,000; whereas with power equipment it could have been performed for $50,000, by employing on the site only half as many men. One may ask why the same amount of money is not taken and spent on two $50,000 jobs performed with power equipment, giving employment on the site of the two jobs to practically the same total number of men.

In the handling and production of materials, the net result in increased employment is more apparent than real; whereas in actual improvement accomplished, the result, as no one will deny, is much in favor of projects executed with power equipment. Advocates of hand labor methods are studying the subject from but one narrow angle. They are thinking only of the men they can see at the site of the work. As a matter of fact, modern industrial development, including the development of power equipment, distributes employment to widely scattered parts of the country. The actual number employed on the site may be small compared with the total number affected. There are men in the quarries and mines producing the raw materials, which in turn give employment on the railroads and other transportation facilities when they are moved to points where they are further refined and manufactured. The manufactured products are often again transported by rail, again affording employment for those engaged in the running of this transportation service, and are finally delivered at the site of the work, there to be placed by means of power equipment in the manufacture of which other men have been employed.

Objection to power equipment is ofttimes raised on the ground that to use it at the present time does not give added employment to those engaged in its manufacture, since such equipment is already at hand for the work and will not be replaced for some time. Actually, in the last two or three years, contractors bidding on public construction work have been making no allowance, or very little, in their bids for depreciation of equipment. According to the best authorities, the result is that over 90 per cent of the contract price has gone into payrolls. Even where an allowance is made by the contractor for such depreciation, there is little question but that he will immediately reinvest it in improved equipment, thus giving further employment to those engaged in its manufacture.

The excuses which have been offered for the use of hand labor methods are identical with those given in favor of the day labor, as opposed to the contract system. It has been said that the emergency does not permit the time to prepare adequate plans and to take bids according to the methods that have proved economical up to the present. Therefore, with the scrapping of power equipment has come a laying off of engineers previously engaged in preparing adequate plans for projects to make them of maximum service to the people.

There is no doubt whatever but that, in well-planned work, on which power equipment and the most efficient methods are used, practically the same percentage of the cost of the job goes eventually into payrolls as does on those projects where inefficient hand labor methods are employed. In the one case the payroll is distributed to a large number of men employed directly on the site of the work, using tools discarded a century ago, to the detriment of modern established agencies for production and transportation; while in the other, the value of the permanent improvement obtained may be several times that produced under the hand labor method.

It would seem that a solution of these difficulties will be reached only when the people are willing to face the facts, to agree that employment at reasonable wages must be given to all those able to work, and then to set up agencies for the planning of projects that will give the greatest return for the money expended. This means, inevitably, the use of power equipment rather than hand methods. That the latter are used at all is proof that somewhere there has been a lack of efficient planning backed by intelligent leadership and cooperation on the part of the people.

Constructive Engineering

Effect of the Emergency Public Works Program on Business Evaluated

By Hugh Miller

Member American Society of Civil Engineers
State Engineer, Federal Emergency Administration of Public Works, St. Louis, Mo.

FUNDS for the construction of public works have been called the primer for the pump that will energize the flow of trade. How this is being accomplished by PWA funds is explained in this article, an abstract of Colonel Miller's address before the Construction Division on January 18, 1934, during the Annual Meeting of the Society in New York. The annual business of the Nation, normally amounting to possibly 900 billion dollars, has been scarcely over 200 billion during the depression. He estimates that the 3.3 billion set aside for public works construction might turn over 15 or more times and thereby add a 50-billion-dollar impulse to the Nation's business—enough of a push on the handle of the pump to start private initiative again. In particular he discusses the problem in Missouri, where for the past six months he has been engaged in sifting out applications for allotments and getting projects under way.

CONSTRUCTIVE engineering may be defined as engineering that supplies every one with more and better goods and services at increasingly lower costs. The particular goods and services that are discussed here are those pertaining to public works. It is agreed that the object of all engineering is to obtain better goods and services at lower costs, to do for one dollar what any untrained man could do for two. While it may not be thought by some that public works ordinarily involve engineering of the same high type that is done by private corporations, yet as far as my observation goes, construction under this public works program is being done and will continue to be done both economically and substantially. Inspection is going to be complete and adequate. Waste and extravagance are being eliminated and funds properly spent.

Most engineers are familiar with the equation of exchange. This equation when carefully studied in connection with the amount of money in circulation and the total amount of bank deposits in the country clearly shows why inflation of the currency will have little permanent effect on business activities. It further shows that the objectives which must be kept in sight to end this depression are to increase bank deposits and hasten their rate of turnover. There must be free spending by those who are able to do so.

EFFECT OF PUBLIC WORKS ON BUSINESS ACTIVITY

When fully operative, the public works program will have the effect of taking idle money out of the banks in exchange for Government bonds. The Government will pay this money to the city, county, state, or other applicant, as the case may be, who will pay it to the contractor, who will pay it to the workman, who will pay it to the grocer, who will pay it to the wholesaler, who will pay it to the manufacturer, who will pay it to the ultimate producer. The ultimate producer, then having more money, will pay it to the grocer, the grocer to the wholesaler, the wholesaler to the manufacturer, and the manufacturer to the ultimate producer again. Three of these cycles constitute 15 turnovers, and if this can be accomplished with $3,300,000,000 in one year, nearly $50,000,000,000 worth of business will result, which is probably 25 per cent of the amount of annual business that has been transacted in the United States in recent years. Irving Fisher in his book, *The Money Illusion*, (1928) estimated that in good times money turns over at the rate of 900 billions a year, and if that represents 1928, there is probably not over 200 billions worth of business annually transacted in the country under present conditions. Statistics as to this are not available.

The equation of exchange may be used to illustrate these points:

$$MV + M'V' \doteq PT \quad . \quad . \quad [1]$$

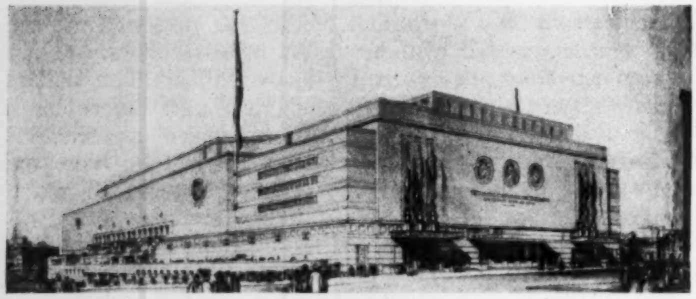
in which M stands for money in circulation; V, for its velocity of turnover in a year; M' represents chiefly bank deposits; V', their velocity of turnover; and PT stands for business activity. This last is composed of two parts, the turnover of actual money and the turnover of credit. The actual money in circulation, M, is about five billion dollars. During the bank holidays, when everybody was hoarding money, it went up to between eight and ten billion dollars. Bank deposits, M', at the present time are about thirty billion dollars. They were up to over fifty billion dollars before the crash and before bank failures tied up many deposits. If frozen bank deposits are released, M' will be increased by several billion dollars. If people begin to make money and put it in circulation then bank deposits will also rise, and M' will be further increased. But roughly bank deposits are about six times as large as the amount of money in circulation. The velocity of turnover may be the same in both cases. It is probable that the money in circulation will never be more than ten billion dollars in this country, because people would not want to carry much more in their pockets than they do now, or banks wish to hold it in their vaults. Money would go back into the banks and be canceled or lie idle. Thus the possible expansion of M is very limited. It makes little difference what is done with currency—whether it is based on silver, fiat money, or anything else—there will be only a certain amount in actual circulation. The idea that the amount in circulation will have any material effect on the volume of business is foolish. All engineers ought to know this and preach it and tell the inflationists in Congress and everywhere else that no matter how much the money in circulation is increased it will not help the situation.

But M' can be increased because there is no limit to bank deposits. It could become 60 billion dollars in ten years, or perhaps sooner. As for V', the bankers could set it going quickly if they wanted to. Here is one way it could be increased. There are architects and engineers who have made out applications for PWA projects for which money is now allotted. They have a lot of money tied up in such items as payrolls and rents, that they are unable to get back at present. They have met their payrolls, and for months they have gone without pay and in some cases will go several months longer. It is hoped the Reserve Bank officials and the bankers will let loose some of the M' that is idle in the banks and loan it to architects and engineers who are working on these worthy projects for which the Government has allotted money. If they would loan them a few thousand dollars each for two or three months, it would ease the situation, and then V' would increase. This is only an example. Many others might be cited.

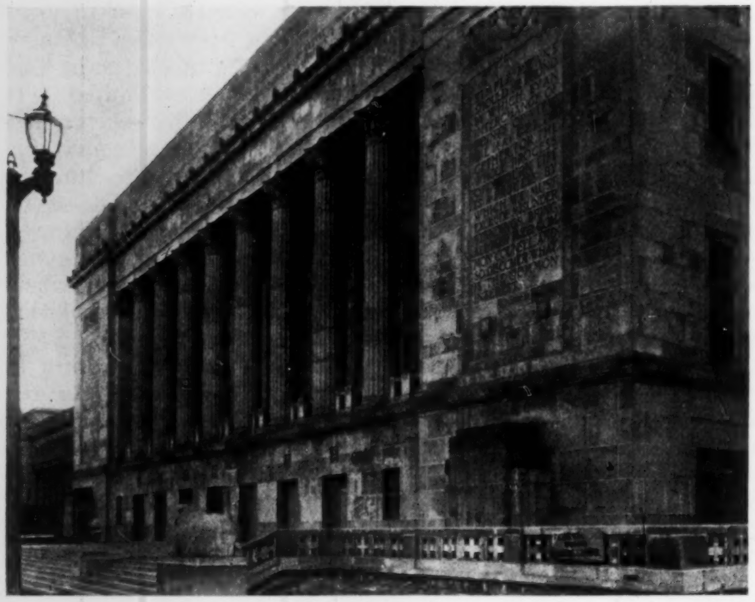
ACTIVITIES IN MISSOURI

The development of the PWA program in Missouri started on August 13, 1933; the Missouri office opened in St. Louis on August 17; and the first engineer examiner was appointed on August 29. By that time there was an accumulation of 10 or 15 projects, but they came in very slowly until the last week in November, when 93 were received in one week. Up to January 13, 1934, a total of 306 applications had been received for projects costing $99,613,530, estimated to employ labor amounting to 275,134 man-months or 22,928 man-years. It is rather interesting that we have a 99-million-dollar total because Missouri's share of the $3,300,000,000, on the basis of population, is about 3 per cent, or $99,000,000. However, adding the funds for highways, for the CWA, for rivers and harbors, for Federal buildings, and for local projects still to be applied for, the total amount of allotments and applications which are likely to be received in the State of Missouri will be about $165,000,000 out of this $3,300,000,000. That does not mean that they will all be approved. Only 50 of these 306 local projects had been approved up to January 6, 1934,

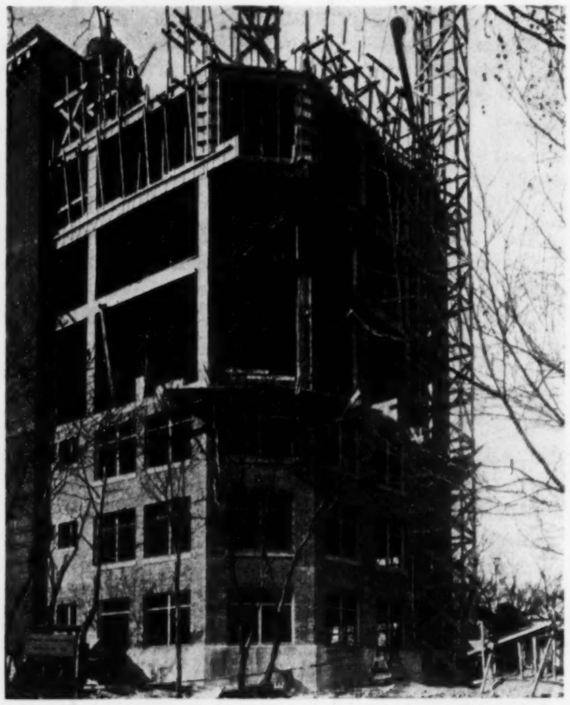
TYPICAL OF SCHOOL BUILDINGS BEING BUILT THROUGH PWA AID
Miller County, Missouri



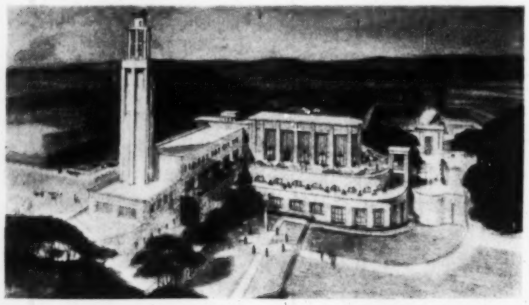
PROPOSED MUNICIPAL AUDITORIUM FOR KANSAS CITY, MO.
Courtesy Alonzo H. Gentry, Voskamp and Neville, Architects



MUNICIPAL AUDITORIUM AND COMMUNITY CENTER, ST. LOUIS, MO.
A PWA Project Nearing Completion



SOLARIUM ADDED TO ST. LOUIS CITY SANITARIUM



PROPOSED DEVELOPMENT OF MINERAL SPRINGS
Project at Excelsior Springs, Mo., Pending Approval

JAIL BUILT WITH PWA AID AT MARSHALL, MO.

but there is a possibility of Washington's approving at least $150,000,000 in the state. It will be possible to secure applications for the State of Missouri for another $135,000,000 which, with the $165,000,000 already applied for or allotted to Federal projects, would bring the prospective program for the state up to $300,000,000. That is merely an estimate based on my knowledge of the state, its needs, its ability to finance its part, and its willingness to vote bond issues.

An official interpretation of the regulations was made in January to the effect that labor and materials on PWA projects will now include contractors' profits and engineering supervision in the field. The rule previously laid down was that contractors' profits and engineering supervision in the field had to be taken out and the 30 per cent grant calculated on the cost of labor and materials to the contractor and not the cost of labor and materials to the applicant. By the new ruling, grants will probably be increased about 10 per cent. Since the City of St. Louis alone has applied for about $6,000,000 in grants, this means an addition of $600,000 to that city.

BONDS ARE BEING VOTED

All over the state it was said that the people would not vote bond issues, so that there was no use in submitting them. But they are voting them, and voting them by the two-thirds vote necessary for general obligation bonds in this state. It is the only way most of the municipalities can finance their projects. If they do not vote them the first time, they try again. The City of Joplin had two projects rejected the first time they were submitted to the people, but they voted on them a second time and both were carried by over two-thirds. When a large number of projects throughout a state is approved and Federal money is allotted, the movement becomes contagious and other communities want their projects approved as well. They realize that on account of the Federal taxes imposed by the National Industrial Recovery Act, which set up the public works program, the people of Missouri are being taxed for the support of public works, and therefore they will be paying for public works in other states if they do not get their share.

Table I. PWA Applications for Missouri
As of January 6, 1934

Type	Number of Projects	Amount
Water works	70	$ 9,130,290
Sewers and sewage disposal	52	13,055,338
Light and power	39	8,515,485
Schools	72	8,226,188
Hospitals	4	3,560,415
Other buildings	28	37,359,472
Bridges	16	9,488,949
Streets and highways	8	7,393,087
Miscellaneous	16	1,261,987
Recreation	9	1,248,658
Totals	314*	$99,813,530

* 8 projects involve two types.

In Table I are shown the classification and the amounts involved in the 99-million-dollar total of applications received to date. The City and the County of St. Louis together now have a potential program of about $47,000,000.

HELP FOR MINING DISTRICTS

To illustrate the great variety of problems encountered, some examples will be given. The district around Joplin is very hard hit by the depression. One project there has been submitted under special legislation which permits the formation of a drainage district for draining the mines. It also provides for the building of a mill to reduce the ore. The application is for $450,000, and since it is a district set up under the state government, it is entitled to a grant of 30 per cent. The Government will get a royalty on the ore mined, and a check on the ore bodies is being made to see whether the security is adequate. If it is, the project may be approved. That will help the district tremendously, as there are many idle miners there now and much distress.

There is another mining field, the Flat River district, where there seems to be no hope for the future, that is, public works projects could not put the people on their feet. A large part of the population—there are 3,000 unemployed in the county—will never be able to get back to work there. There are 2,500 on CWA work temporarily, but the ultimate solution appears to be to put them on subsistence homesteads, perhaps in the foothills of the Ozarks, where the land is suitable for cultivation and where they will be self-sustaining. That plan is now on foot and there is hope that it can be carried out in the near future.

Of course the large centers of unemployment are St. Louis and Kansas City. There it is hoped that public works will be large enough to take up the slack. The most interesting cities as far as this problem is concerned are Springfield and Marshall, which now have their unemployment taken care of almost 100 per cent by CWA. Public works will take care of it after the expiration of the CWA, which is exactly what the President's program anticipates.

PLANNING FOR THE FUTURE

It was the engineers who proposed the public works construction program and foresaw its effects on business. Many economists think that the construction industry is the major factor in booms and depressions. When the industry is active there is a boom, and when it is slack there is a depression. The construction needs of the country for the next two years have been estimated by competent authorities at 13 billion dollars, but this may be too low. From my experience in Missouri, I arrive at an estimate of 20 billion dollars for both public and private work for the next two years for the United States. If this amount of construction can be accomplished in the next two years and private construction can be stimulated as public works slacken, the depression will be over.

An important duty of the State Engineer (PWA) from now on will be the planning of public and private works for the future. He will have to cooperate with private companies in planning their construction. It is with the authorization of Secretary Ickes that I make the following statement:

"At the suggestion of the National Planning Board, the governors of 19 states have appointed state planning boards for the purpose of making a complete plan for the development of the natural resources and future public works of their respective states. It is the duty of all State Engineers, with the assistance of the State Advisory Boards, to cooperate fully with these State Planning Boards."

In Missouri our board is an excellent one, comprised of about 15 outstanding citizens. These include the President of the American Institute of Architects, the Chief Engineer of the State Highway Commission, the State Geologist, the State Sanitary Engineer, and others equally important. The cooperation of my office has been offered them and the offer has been accepted. For the next few months planning will be an important part of the work of the PWA office of Missouri.

Reports of Society Committees

Received at the Annual Meeting of the Society, in New York, January 17, 1934

COMMITTEE ON CONCRETE AND REINFORCED CONCRETE ARCHES COMPLETES TESTS

THE COMMITTEE on Concrete and Reinforced Concrete Arches has been studying the problems connected with the design and construction of such arches for the past ten years. In addition to a study of existing data from various sources, the committee has sponsored a number of original researches. The most extensive of these was conducted at the University of Illinois under the able direction of W. M. Wilson, M. Am. Soc. C.E., a member of the committee. This investigation, in progress for the past three years, included the erection and testing of a number of single-span and three-span arch systems with and without a superstructure. These arch systems were made of reinforced concrete and were about 100 ft long and nearly 40 ft high. So far as the committee knows, they are the largest working models of arch bridges ever tested.

Now that the tests are completed, the committee is engaged in studying the vast amount of data that has been accumulated. The final report will include the conclusions reached; and it is proposed to submit a recommended procedure and specification for the design of single-span and multiple-span arch systems with and without a continuous superstructure. It is hoped that the final report of the committee will be ready for presentation to the Society at the Annual Meeting in January 1935.

Respectfully submitted,
CLYDE T. MORRIS, *Chairman*

COMMITTEE ON EARTHS AND FOUNDATIONS OUTLINES WORK FOR THE FUTURE

A PROGRESS report of the Special Committee on Earths and Foundations, which appeared in the PROCEEDINGS of May 1933, was devoted to the solution of the problem of settlement of structures erected on soils containing strata of fine-grained, saturated materials. The discussion invited by this report was very gratifying to the committee, which hopes to contribute a closing discussion in the near future.

The committee has continued its researches, but on a reduced scale as befitting the times, and hopes to become more active in the future. It has been asked to include with its other work, research work on earth dams and the flow of water beneath them in porous strata. This investigation will be conducted by means of models in connection with the construction of locks and dams on the Mississippi River.

Research work on foundations will be continued this year both in this country and in Europe, where Charles Terzaghi, M. Am. Soc. C.E., now in Vienna, will proceed with his work of recording settlements and conditions of existing structures erected on fine saturated materials, as well as his theoretical and experimental laboratory work.

In this country, at Columbia University, research will be conducted on the nature of earth pressures on retaining walls and tunnels. This work will be performed by Prof. Philip B. Buckey, utilizing an original method combining the centrifuge with the photo-elastic process. At Harvard University, Dr. Arthur Casagrande will investigate further the properties of clay. At Yale University, Dimitri P. Krynine, M. Am. Soc. C.E., will continue his investigation of the holding power of piles and sheeting. At the Massachusetts Institute of Technology, Glennon Gilboy, Jun. Am. Soc. C.E. will continue his study of the consolidation of soils.

Respectfully submitted,
LAZARUS WHITE, *Chairman*

COMMITTEE ON METEOROLOGICAL DATA REMAINS ACTIVE

DURING the current year the activities of the Committee on Meteorological Data have been limited primarily to correspondence on general subjects. Rain gages installed at varying elevations at the Los Angeles City Hall by the Board of Public Works, and certain experiments initiated by the committee concerning registration of precipitation, being carried on at the University of Southern California in Los Angeles, were continued.

Until such time as the pending reorganization of the Weather Bureau becomes effective, only nominal activity can be expected from this committee, but its continuance is recommended in order that it may be in existence at such time as the reorganization of the Weather Bureau becomes a fact, so that changes of interest to engineers may be suggested and sponsored by it.

Respectfully submitted,
DONALD M. BAKER, *Chairman*

COMMITTEE ON IRRIGATION HYDRAULICS RENDERS FINAL REPORT

AUTHORIZED in 1922 under the chairmanship of D. C. Henny, M. Am. Soc. C.E., this committee has continued with practically unchanged membership until, for reasons of economy, it was discharged upon its own motion to take effect on December 31, 1933. During its existence it has covered a wide field of investigation and has acted as a clearing house for worth-while data. Its labors have meant much to the hydraulic engineer and have resulted in the publication of numerous papers by the Society. At the Annual Meeting of the Society in January 1934 its final report was rendered. It is to be printed in the March issue of PROCEEDINGS, where it will be available shortly after March 15. The committee, discharged with acknowledgment of its fine devotion and generous gift of time, consists in addition to Mr. Henny, of B. A. Etcheverry, George W. Hawley, Ivan E. Houk, Morrough P. O'Brien, R. L. Parshall, J. L. Savage, Fred C. Scobey, I. C. Steele, Franklin Thomas, and J. C. Stevens, Secretary, all members of the Society.

Flow of Water Through Sand

Brief Review of Paper Read Before Sanitary Engineering Division on January 18, 1934

By GORDON M. FAIR
MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
ASSOCIATE PROFESSOR OF SANITARY ENGINEERING, HARVARD GRADUATE SCHOOL OF ENGINEERING, CAMBRIDGE, MASS.

WHEN engineering works in which ground water plays a part are to be designed, it is important to have a full understanding of the behavior of water in its flow through the soil. Waters flowing through natural sand or gravel deposits furnish the domestic supply of many communities. Waters insufficiently pure for consumption or unattractive in appearance are passed through filter beds of sand, and rendered safe and attractive. Waters leaching into the soil from irrigation ditches supply the moisture requirements of crops. Waters seeping out of the soil into drainage canals reclaim swamp lands for agricultural use. Waters flowing through earth dikes under earth or masonry dams of impounding reservoirs are lost from storage. Waters seeping into excavation interfere with construction and sometimes cause quicksand conditions that are difficult to overcome.

The study of the laws governing the flow of water through sand had its scientific inception nearly a hundred years ago in the work of Poiseuille and Darcy. Starting from the well-known formula for the flow of water through pipes, a rational expression of the flow of water through sand was obtained by regarding the pore space of sand as a series of tubular passages through which water flows in much the same way as it does through interconnected pipes. The factors that enter into the formula are the frictional resistance of the sand, the velocity and temperature of the water passing through it, the void space through which the water flows, and the size, shape, and packing of the sand with which the flowing water comes in contact.

BASIC CONCEPTS OF SAND SIZE AND SHAPE

An examination of the fundamental equations for the flow of liquids through pipes and through sand will show that the chief difference between the two equations is in the factors that describe the passageway through which the liquid flows. In the case of pipe flow the passageway is defined by a single factor, the pipe diameter, or the hydraulic radius. In the case of sand flow there are three factors: the sand volume, the sand area, and the porosity ratio. If a sand bed is considered to be made up of N uniform spheres, the collective surface, A, and volume, V, of the N spherical sand grains would assume the values of $N \pi d^2$ and $\frac{1}{6} N \pi d^3$, respectively, and yield an area-volume ratio of $\frac{A}{V}$, equal to $\frac{6}{d}$, where d is the diameter of a sphere. Here d may be called the measure of size, and the constants π, $\frac{1}{6}\pi$, and 6 may be called measures of shape. Although an irregular grain of sand has no single diameter as such, and the measure of shape cannot be evaluated theoretically, it will be convenient to think of sand size as defined by a linear measure, or diameter, and of sand shape as indicated by constants that yield area and volume, or the area-volume ratio when multiplied by the square, cube, or reciprocal of the so-called diameter.

The grain structure of a sand bed may vary in a number of different ways that will affect the magnitude of the weighted average area-volume ratio of the sand. Among these different grain structures the following may be distinguished in particular: (1) uniform sand; (2) non-uniform sand, non-stratified; (3) non-uniform sand, stratified with uniform voids; and (4) non-uniform sand, stratified with non-uniform voids.

Uniform sand is a type encountered only rarely in natural or in man-made beds of sand. Non-uniform sand, non-stratified, is generally achieved in slow sand filters and is approached in many cases of ground-water flow through natural soils and through rolled embankments of truly sandy material. Voids and packing will generally be found to be substantially uniform.

Non-uniform sand, stratified, with uniform voids is achieved without resorting to hydraulic stratification. Approximately the desired bed structure can be obtained by passing the sand through a series of sieves and then packing the separate sievings into the column in order of size. In general, the porosity ratio of the various layers of sand, composed of substantially uniform grain sizes, would be almost constant and the depth of layer created by each sieve-separated part is therefore proportional to its weight. The grading, however, would produce area-volume ratios varying from large values at the top (fine grains) to small ones at the bottom (coarse grains). Hence the frictional resistance would be greatest at the top and smallest at the bottom. This type of bed structure is achieved in rapid sand filters and in the inward as well as outward percolation of water through the beaches of hydraulic-fill dams constructed of sand. The flow of ground water through stratified sedimentary deposits may also approximate this type of flow.

Non-uniform sand, stratified, with non-uniform voids is encountered when rapid sand filters are backwashed or when quicksand flow occurs in nature. The sand is lifted, the smaller sand grains being held farther apart than the larger ones.

Substituting in the general flow equation the values of $\frac{A}{V}$ for different conditions of bed structure, the formulas for the flow of liquids through beds of sand may be obtained.

Three different groups of materials have so far been studied in the laboratory: (1) fifteen uniform sands from four different sources and differing markedly in size and shape; (2) glass spheres substantially 3 mm in diameter; and (3) six non-uniform sands, each having approximately the same Hazen effective size but markedly different Hazen uniformity coefficients. Tests were devised to cover the entire range of variables entering into the different flow equations, and the results obtained support the theoretical formulas in all particulars.

There appears to be no reason why the formulas suggested should not apply to the flow of liquids other than water through materials other than sand. The new formulas that have been developed are the outcome of a study conducted during the past three years at Harvard University by L. P. Hatch, Research Fellow in Sanitary Engineering, under my direction.

Functions of the Construction Engineer

Discussed from the Points of View of the Contractor and of the Designer

JUST as engineering talent is necessary for the preparation of a proper design, so also is it necessary in connection with its construction. Speaking from the standpoint of the designing engineer, Mr. Crocker states that all too often the designer entrusts the inspection of the work to inexperienced and underpaid men, frequently recent graduates without an adequate understanding of field construction problems. Engineering colleges would do well, he feels, to include courses in construction methods and equipment in their curriculums. In speaking for the contractor, or "constructioneer," Mr. Greensfelder states that in the past construction engineers have been prone to think only of how to make better concrete or brickwork, to the neglect of the basic economic problems of the industry. He considers the problem of unemployment from several angles and lists new fields of opportunity which he feels construction engineers might cultivate with profit. The papers of which these two articles are abstracts were presented on January 18, 1934, before the Construction Division at the Annual Meeting of the Society. Both speakers stressed the desirability of responsible recognition of the fundamental duties of construction engineers and expressed the hope that their views would call forth general discussion.

The Engineering Viewpoint

By HERBERT S. CROCKER

PAST-PRESIDENT AMERICAN SOCIETY OF CIVIL ENGINEERS
CONSULTING ENGINEER, DENVER, COLO.

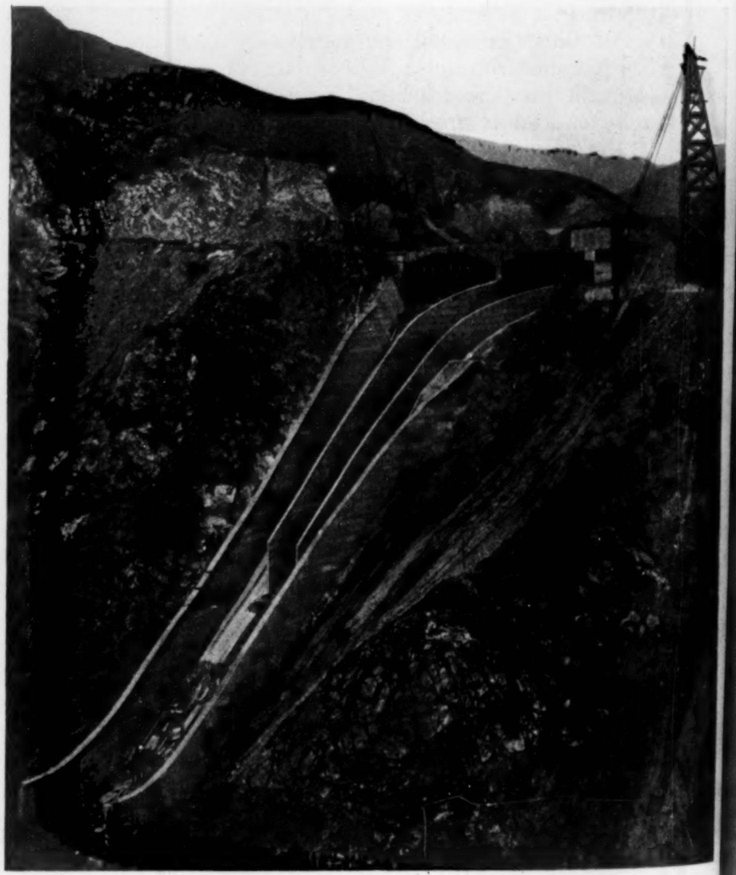
AT the present time the relations between contractor and engineer are the no-man's-land of the construction industry. It is filled with problems which are only indistinctly seen but which are frequently fruitful in discord, waste, and inefficiency. To say that both engineering and contracting would not benefit by a thorough airing of these problems is to take a highly romantic view of the situation.

On various occasions I have been at the same time on several distinct jobs—as engineer on one and as contractor on another. I well remember one of my contracts. The specifications called for the use of concrete containing a coarse aggregate of 1 in. maximum diameter. That was down in black and white. Aggregate of $1^1/_4$ in. diameter was available and to save time and expense, I wanted to use it as a substitute. The young field engineer replied by pointing to the specifications. These called for 1-in. aggregate, and 1-in. aggregate he proposed to have. So the rock was rescreened and recrushed and finally reduced to the specified size after considerable delay and additional expense. The work is no better today for it. At the same time I was acting as consulting engineer on another piece of construction of similar character. A few days after this experience my own field engineer came in with the news that the contractor wanted to use $2^1/_2$-in. aggregate instead of the 2-in. that was specified. In the exercise of honest judgment I could not refuse the concession.

These are small matters, perhaps; but it is such conflicts as these—which need not be conflicts at all in two cases out of three—that frequently spell the difference between a job that is unnecessarily costly and sometimes inferior in quality, and one that is both profitable to the contractor and creditable to the engineer. A few shifts in emphasis within the profession would suffice to eliminate a good share of the difficulties.

Now, to consider how this trouble arises, when a young engineer leaves school in normal times two courses are open to him. He may go into the drafting room, that is, into work which is concerned directly with design rather than execution; or he may go directly into the field, as inspector, instrumentman, or such; that is, he may become a field engineer. There are advantages and disadvantages in each of these initial steps.

If the young engineer enters the drafting room and



PINE CANYON DAM

Water Supply Storage Structure for Pasadena, Calif., Was Built in
More Than 16,000 Acre-Ft in Storage. It Is One of Six Flood Release
Discharged 4,000 Cu Ft per Sec. The Spillway Capacity Is 80,000 Cu

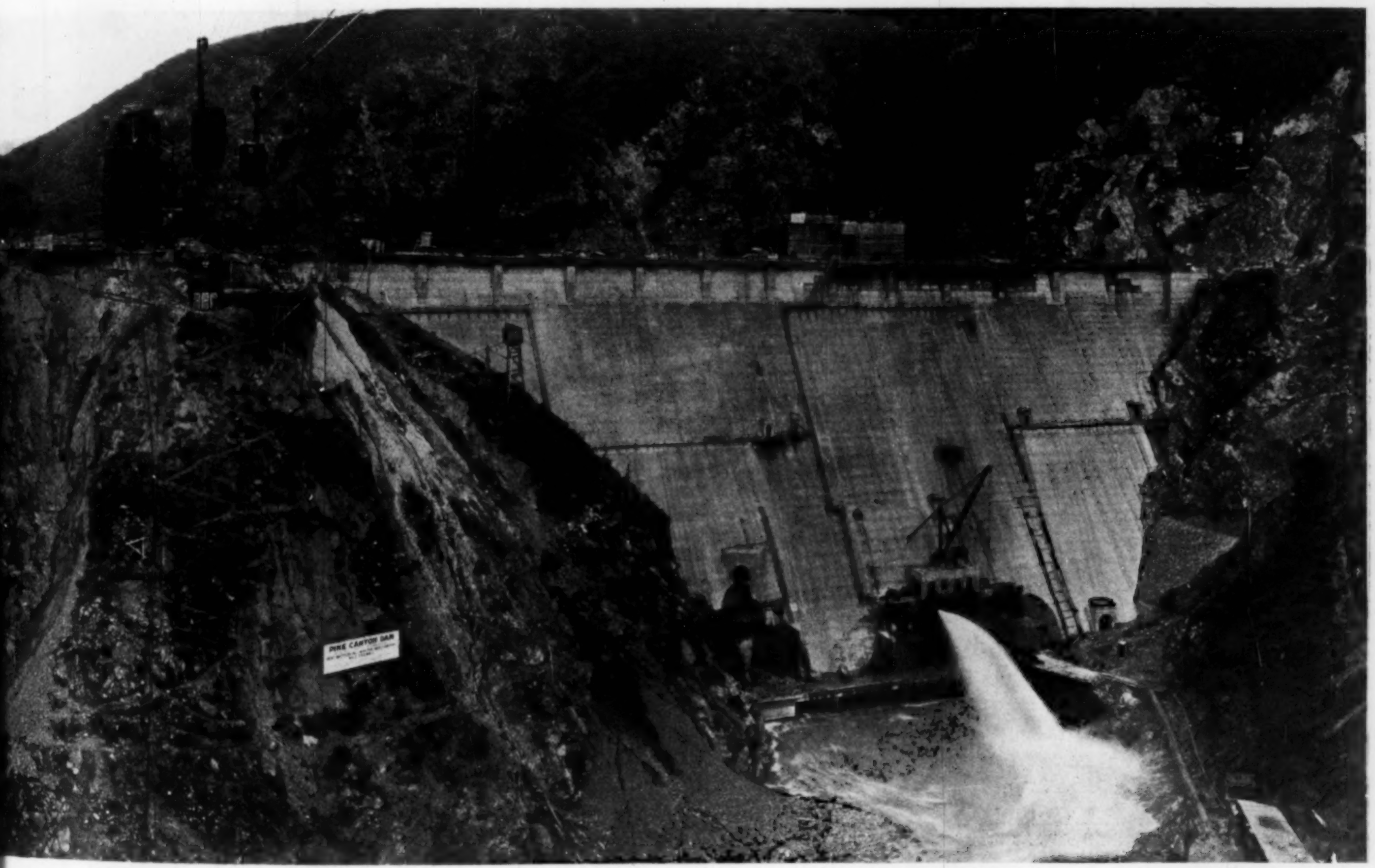
engages in the designing end of engineering, he is able in the shortest possible time to put in use the results of his studies. He finds immediate and direct application for the theory and the technical knowledge that he has spent at least four years in absorbing. The drawback is, of course, that he may fail to realize the distinction between theory and reality. He finds it hard to understand that field difficulties can frequently nullify the best-prepared design. He sees his plans not as something which must be executed, but as a finished product which the contractor, by some secret magic of his own, must bring into being. To be blunt about it, the designer with inadequate experience in construction problems tends to become a literal minded hair-splitter, who is irritated whenever the construction fails to look like the picture he has drawn. I recall some plans for raising the level of a viaduct by several feet, which called for the placing of enormous castings between the supporting piers and the end bearings of the viaduct trusses. Obviously the designer had not given the slightest thought to the problem of getting these huge castings in place. He demanded an impossibility under the limitation of clearance, and the plans had to be redrawn.

Suppose, on the other hand, that the young engineer goes first into field work, rightly believing that he cannot become an all-round engineer until he has had some experience in it, and expects to go from it to office work. He has a more exciting time, perhaps, but when he does finally turn to the office, he is at a temporary disadvantage when dealing with questions of design. Field work makes relatively little demand on his newly acquired technical knowledge, and he is apt to grow rusty. Whether experience begins in the office or in the field depends largely upon the opening that first presents itself. However, there seems no doubt that the fullest measure of financial success and professional reputation comes to the engineer with both kinds of experience, provided he is gifted with sound judgment and possesses that rare qualification, the ability to handle men. In any just analysis of the engineer's duties, field responsibility is every bit as important as the responsibility for correct design.

ENGINEER VERSUS OWNER

Consider the relation between engineer and owner, or client. The engineer must first make plans to suit the owner's requirements. They are accepted, bids are submitted, and then the engineer assumes a wholly different rôle—that of arbitrator between owner and contractor. In the contract between these parties it is stipulated that the engineer's plans shall be followed; that in case of dispute he is the sole arbitrator; and that his judgment is to be final and binding.

It may be doubted whether such a stipulation is legally defensible. The engineer is the paid employee of one of the parties, that is, the owner. But the idea behind it is reasonable enough. It is based on the assumption that the engineer possesses superior technical knowledge. Fortunately this theory does not always fit the facts these days. The age of the rough-and-ready practical contractor on important work is drawing to a close. He is being superseded by the contractor who realizes the value of an engineering staff of his own and in fact finds such a staff necessary because of



Nearly Complete, in January 1934

the San Gabriel Canyon to Store Flood Waters. In Photograph One of 42-In. Needle Valves Is Seen Discharging 200 Cu Ft per Sec with Outlets Having a Total Capacity of 6,000 Cu Ft per Sec. During the Heavy Rain of December 30, 1933, to January 1, 1934, the Valves Ft per Sec with a Head of 23 Ft Above Spillway Lip. Photograph Courtesy of S. B. Morris, M. Am. Soc. C.E., Chief Engineer the more elaborate and technical nature of much modern construction work. Many a designer whose plans call for, say, an intricate outline of reinforced concrete, would be at a loss if he had to design the forms in which this concrete is poured. Frequently the contractor must solve engineering problems which have never occurred to the designer, and with which he would probably be unable to cope.

In view of this, it is no longer possible to assume the invariable superiority of the engineer. The situation is made even worse, practically, by the current emphasis on the design rather than on the construction side of the engineer's work. This means that while the contractor is constantly improving his technique, the quality of the engineer's field men is tending to deteriorate. More and more, the field work of the engineer is being turned over to the untrained and the inexperienced.

EXCAVATING FOR A RETAINING WALL ON NORTH 12TH STREET
St. Louis Electric Railway

The really competent field man knows that a plan is merely something to approach—an ideal which it would be highly gratifying to achieve, but which nine times out of ten he will fall short of. A plan, to him, is something which constantly calls for compromise. He can, and does, frequently waive requirements in plans, to the benefit of both contractor and owner. The untrained or incompetent field man takes his plans literally. He will require that a row of concrete piles, whose heads are to be embedded in a concrete foundation anyway, be chipped off to exact level. If the drawing shows precise and beautiful curves where the bridge joins the land, he will force the contractor to execute those curves with meticulous care although eventually they are intended to be covered with dirt. He is, to be brief, a nuisance, interested mainly in achieving the impossible, and the principal cause of most contractors' gray hairs even as contractors are responsible for many a white-headed engineer.

Occasionally a field man will go even further than this and start off with the assumption that the contractor is some one to "get." He feels that he hasn't really done right by the owner until he has thrown every obstacle he can think of in the path of the contractor, and his notion of the highest virtue is, apparently, to wear out as many contractors as possible. From his point of view the cards are all stacked in his favor. For in writing the contract the engineer is not content merely to make specific provisions; he adds a sort of blanket clean-up clause to the effect that the contractor must do a good job generally—"all work must be performed to the satisfaction of the engineer." The contractor hesitates to challenge this. After all, he is in the contracting business; he hopes for future business. Therefore he frequently takes a loss rather than risk the reputation of being a "kicker." In consequence the sorest point of the contractor-engineer relationships, that of incompetent field work, seldom comes to a head.

Perhaps it is not possible to work out the waste involved in this state of affairs in terms of dollars and cents. Yet it is unquestionably a huge burden on the construction industry as a whole. On the one hand there are the losses sustained by contractors who must put up with incompetent field men: on the other there is the added cost to the owner passed on to him by contractors who often find it wise to include in their estimates an allowance to cover expenses arising from this source.

COLLEGE TRAINING FAULTY

These conditions are frequently not the field engineer's fault. A large proportion of the field inspectors are young and inexperienced men, who have hardly more than an inkling of the nature of the practical problems which they must face. While in college they are required to devote most of their attention to the elements of engineering education which cannot be mastered except by study. They must concentrate on the theoretical elements; and as the technical side of engineering grows more and more complicated, the engineering schools must devote more and more time to the purely technical side, to the still further neglect of the practical. Consequently little time remains for the field side of the work, which by tradition is left to the university of hard knocks. But although the colleges can hardly be expected to turn out students with practical experience, they owe it to their students to give them some notion as to the problems they will have to solve when they get out in the field.

The father of a young engineer who was in the employ of a contractor, as a superintendent, recently told me a story which illustrates the present haphazard ways of acquiring field experience. The work called for the placing of a large piece of machinery on a high tower. The young engineer was greatly worried because he could not see how to get it up there. But finally he ceased worrying, and some one asked him why.

"Well," he said, "when the time comes I'll just tell my foreman to put it up and then I'll go to town for the mail."

If he was a wise young man he hid behind a tree, on his way for the mail, and from that vantage point got a practical lesson in construction methods.

An education which must be gleaned from behind trees has its flaws. More emphasis in the colleges should be placed on construction methods, on the limits of compromise in the field, and on related problems. Such preparation would hardly provide the student with a mature and balanced judgment, but at least it would make the acquisition of such judgment somewhat easier.

Yet even that would fail to contribute much to relieve the difficulty unless it were coupled with something else—an improvement in the status of the field man within the profession. At present he is definitely underpaid, and he is not encouraged to take responsibility into his own hands. When called upon to make a decision in the field, he finds it easier and safer to fall back on the letter of the plan, even when good sense and justice to both owner and contractor demand that the plan be modified somewhat. More than one field engineer has suffered at the hands of his superiors because he ventured to take the initiative.

Initiative and a sense of responsibility, joined with experience and good judgment, are the most valuable qualities that a field man can have. The solution of the problem lies in the inclusion in college curricula of courses in the technique of construction machinery and its uses, as well as studies of field methods of erection and handling of materials in an economical manner. The state of the art has reached the point where inexperienced men cannot safely be intrusted with the making of important field decisions. They cannot be allowed to gain experience through their mistakes; therefore a field organization on work of any magnitude should be headed by at least one thoroughly experienced engineer, under whose supervision the younger men could gain their experience. If some measures were taken to put these reforms into effect, then there would soon be no need for words like these.

The Field Construction Viewpoint

By A. P. Greensfelder

Member American Society of Civil Engineers
President, Fruin-Colnon Contracting Company, St. Louis, Mo.

At the beginning of this century only a few civil engineers had joined the ranks of those general constructors who undertook to execute the civil engineering works of America. Civil engineers as they graduated from college previously sought and found places on the staffs of consulting engineers or of public engineering officials. In recent years, more and more such graduates, and even older men of more or less practical experience, have entered the construction field. Previous to the organization of the Construction Division of our Society, less than a decade ago, there was little opportunity for the construction-minded engineer to contact his fellows.

In the proposed Code of Fair Competition for Professional Engineers the functions of the professional engineer are recognized as the planning and supervision of work, leaving to the constructor and his "constructioneers" the superintendence, coordination, and execution of it. This distinction is proper and practical.

The term "constructioneer" was originated and adopted by the Constructors' Personnel Institute of America, an organization created through the initiative of The Associated General Contractors of America a year ago at Detroit, for the benefit of the executive, managing, superintending, and technical personnel of general contractors' organizations, as well as of students in and graduates of construction courses. The special aims of the institute are: to establish an official national institution of constructors' personnel and to obtain due recognition as such; to encourage men to improve their skill in construction methods; to promote sound principles and safe practices in construction work; to provide a medium for cooperation and to foster fraternal relations among its members; to better the general welfare of worthy men with proved ability in construction and stabilize their employment; to cooperate with educational institutions in providing adequate courses in construction methods and management and furthering construction research; to encourage high-grade students in electing courses in construction; to assist graduates through particular training and apprenticeship in construction operations; and to improve industrial relations pertaining to the construction industry.

Regulations of the institute are patterned after certain parts of the Constitution and By-Laws of the Society, but do not contain solely engineering qualifications. There is no occasion for confusion between the institute and the Society or its Construction Division. On the other hand, it does offer opportunities for joint endeavors of civil engineers and practical construction men to promote general interest in constructive and practical phases of construction work. One should supplement the other. This cooperation is assured through the recent selection of A. E. Horst, M. Am. Soc. C.E., as a member of the Executive Committee of the Construction Division, who is also the present National Administrator of the Constructors' Personnel Institute.

5.

FUNDAMENTALS VERSUS DETAILS

One of the modern problems relative to construction is stabilization of the industry. This is an engineering problem and is subject to engineering analysis. It is also an economic problem, and therefore engineering analysis must include the field of economics. Engineers have been frequently criticized because of their tendency to study only the details of construction rather than the broad problem of construction cycles and construction needs. We must all realize that construction depressions follow construction booms. If engineers can devise some psychological remedy for booms so that the depressions which follow need not be so acute, then all concerned would have a smoother road to travel.

Pioneering days in America are over. The national terrain has been thoroughly explored. New fields of opportunity must, therefore, be developed if the construction engineer is to have regular employment. Whether this entails reduction of hours per day, days per week, or weeks per year should be promptly determined. It may mean numercial control of university education by determination of aptitude and ability, or perhaps a shorter range of employment by raising the age limit at the bottom and providing for earlier retirement at the top. Whether prequalification of construction engineering experience should require field apprenticeship or what other phases of promotion requirements are essential, also must be given consideration.

VIRGIN FIELDS FOR THE CONSTRUCTION ENGINEER

Study would also seem essential to provide broader employment of construction engineers in different branches of the construction industry. They may find opportunity in the shops, mills, or plants which are prefabricating many of the construction materials and units which formerly were assembled in the field. Shop fabrication of metal forms, concrete mixing in central plants, shop welding of reinforcing steel units, and the design of power-operated construction equipment, are examples of possibilities. The marketing of such prefabricated or power units is also calling for construction engineers. Transportation of construction units of ever increasing size and weight at relatively high speed, with delivery coordinated to field erection, from fabricating plants many miles from the erection site, would seem to offer certain possibilities. The development of these factors in turn will present new field erection problems and processes.

Greater use of new machinery, such as belt conveyors and pumps for handling bulk cement, prefabricated floor and wall units, and combined plumbing and heating units is opening up fields for inventive minds. The lack of efficiency after an accident and the increasing cost of workmen's compensation insurance indicate the growing need and great opportunity for construction engineers to develop safety in field construction procedure.

Among the matters of general interest that must be given careful consideration by the construction engineer is the present tendency to require hand labor in times of depression instead of the normal use of power equipment. This tendency must be overcome if there is not to be retrogression in construction methods. Production per man-day must continue to increase if wealth per man-year is to increase.

ORGANIZATION OF WORK

Construction engineers must presently consider the relative efficiency, from the viewpoint of the community and the taxpayer, of private organizations and political day labor. The tendency of the National Government to decide and dominate the construction programs of the country deserves prompt consideration. Party affiliation does not necessarily indicate adequate construction experience or incentive.

Just how far public utility companies, which are in essence private monopolies, with rates based on capital expenditures rather than on minimum unit costs, are warranted in doing new construction work with their own forces rather than under a competitive contract system is a much disputed matter. Perhaps there will be needed a revision of accounting methods of public utilities and facilities to determine actual unit construction costs. The trend in many companies and public officials not to include bond and insurance premiums, general overhead, equipment rental and depreciation, office and storage-yard expenses, does not make for fair comparisons of construction costs. Whether the consumer pays for his facilities in taxes, rates, or rents, he will presently insist upon knowing "the truth, the whole truth, and nothing but the truth" regarding them.

One of the major items of construction expense is the element of finance. Construction engineers must make it a part of their job to study such questions as the following: What period in the economic cycle can people be induced to vote bonds for construction projects? At what point in the interest curve should such bonds be sold, and in what period of the employment graph will these bond funds buy the greatest amount of construction and minimize unemployment? Construction engineers should consider which public works should be financed through bond issues, which should be paid for from general revenue, and which should be assessed as special taxes to benefited real estate or direct users.

Engineers are vitally concerned, although they may not realize it at present, whether gasoline and automobile taxes are segregated and used only for highway purposes, or whether they are diverted for school teachers, fish

SHURN-COLKON
CONSTRUCTION CO.

THE CONSTRUCTION ENGINEER MUST KNOW EQUIPMENT AND MACHINERY
Erecting Subway Steel for the St. Louis Electric Railway, St. Louis, Mo., 1931

hatcheries, and many other foreign purposes. The new suggestion of placing sewer systems on a monthly rate basis, the same as water service, is an example of what can be evolved if engineers will concentrate on analyzing financial trends.

How much tax should real estate bear and how much should be directly charged as tolls or for service? Toll roads and bridges have come and gone through the ages, and yet the principles of where, when, and for how long tolls should be collected are seldom included in any engineering college or professional program. Should tolls be collected only until the property is amortized, and if the toll income is insufficient to pay carrying charges, what then?

Should parks, playgrounds, and recreation facilities be entirely met by "pay-as-one-plays" programs, or should the acquisition of the land be spread over several generations? Should schools, libraries, hospitals, and churches be placed indiscriminately throughout the land, or would it be better for the users and the taxpayers to concentrate the facilities in communities of reasonable size, and provide all-weather roads and buses to collect the patrons? These examples do not begin to exhaust the the list of possibilities which need exploration by constructive minds. Housing is perhaps one of the most vital construction problems facing the country today, and resourcefulness in construction will not be sufficient to solve it.

One of the ripest opportunities of the day for construction engineers is the necessity for solving the relation of climate to construction. The work of the Committee on Seasonal Operation in the Construction Industries of the President's Conference on Unemployment has demonstrated conclusively that it is "custom, not climate" which governs our present work periods. Just what, where, and when winter work is worth while is still an open question. Should construction engineers migrate from north to south during the winter and retrace their steps during the summer, or should temperature control be put on a scientific basis? In the same category night work might be mentioned. Shall our highways be constructed in 24-hr periods and thus hasten their completion, or should the possibilities of the electric light plant or network of power wires be ignored?

In many parts of the country, on many kinds of projects, facilities are reconstructed at the time they are most needed. Streets and highways are built in the summer when traffic is the densest. How long this should continue is a mathematical problem and should not remain a traditional one.

CONSTRUCTION CONTRACTS

It is not the province of this paper to discuss details of construction contracts, but the welfare of construction engineers is bound up in the problem of providing equitable contracts. Perhaps prequalification of construction engineers would seem as essential as that of constructors themselves. To say that a law does not permit an equitable form of contract is no defense. Law is man made, and can be changed by man whenever it is to his interest to do so. The tendency today is toward "free-for-all" competition at a lump-sum price. To my mind, this does not necessarily prove that it is the most efficient or economical form of contract. The same procedure which warrants an owner selecting a designer without competition would seem to warrant in many cases the selection at the same time of an honest, experienced constructor under a sliding-fee form of contract, in which the interests of all parties would be the same. Perhaps both the designer and constructor should be rewarded with a share of any reduced cost that their individual or joint ability and ingenuity produced during the construction period. What the construction engineer should endeavor to evolve is the best bid at the best price rather than that of the lawyer's maxim, "the lowest responsible bidder's figure."

Construction services should not be subject to any more hazards than are really necessary. Why should a constructor be required to give a bond to perform his part of a contract and the owner not furnish one likewise, to ensure payment to the constructor? "Bi-party bonds" are not merely wishful thinking; they are destined to become recognized equitable construction procedure. "Structure insurance" is a term now given to a single "all-risk" policy to ensure a structure against loss or damage, however caused. Insurance brokers at the present time evidently do not know enough about construction to sell constructors sufficient insurance coverage, and constructors do not know enough about insurance to seek or demand full coverage.

Another step to insure man against himself is adequate uniform cost accounting. Perhaps under the codes of NRA, such accounting methods will be evolved. Then it could follow that bidding below cost would be breaking a national law.

For some unknown reason engineers have been taught that engineering should be a secret science, that its problems and purposes must be modestly hidden from the public gaze or knowledge. As a result, the public knows little about the genius of engineers. Yet people flock by the thousands to look at the new construction methods on the huge Boulder Dam, even though it is far out in the desert. Equally curious people so surround a steam shovel in cities that it is necessary to build a tight fence around the entire project. Safety is important, but why not provide a public observation platform with a guide to explain the work and the reason for it? It is not my thought that engineers should follow the advertising methods of quacks or seek undue publicity. But why reject such publicity as in proper professional fashion can give fair advertising to engineers and their construction projects?

POSSIBILITIES OF CODES

Construction codes have vast possibilities as well as perplexities. Codes can correct many of the unsound and devious devices of the construction industry. Whether bid padding and bid peddling can actually be eliminated, or be made only to disappear under the surface, will be watched with great interest by the entire construction fraternity. Many designers and owners have been guilty of the worst kind of bid peddling. Publicity may be the answer. Opening of bids in the presence of bidders on private as well as on public work may prove to be the next step, or the filing of duplicate bids. An engineer has suggested that if the owner or designer does not invite bidders to be present at a letting of private work, then the bidders should hold an open letting and invite the owner and designer to be present. Evidently this would need to be done but once in a community to prove self-corrective.

Construction engineers today must devote some of their constructive thought to the problems of the entire construction industry and not merely endeavor to make better concrete or brickwork. The successful construction engineer of tomorrow may not be a physical giant or a mental genius, but he will realize the need for broad guidance of sound construction demands and methods and then will proceed to create the appropriate supply.

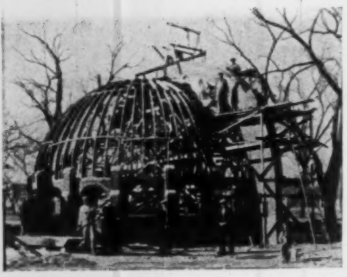
Advantages of National Planning

Emergency Conditions Emphasize Need for a Coordinated Program of Government Spending

THAT the country has become "planning minded" is evidenced by the many town, city, and regional planning commissions which have been persistently attacking their local problems for years. But the present national economic crisis has brought out with sudden emphasis the fact that practically nothing has been done about a national plan. How can emergency relief moneys be wisely spent unless the projects to which they are allotted conform to some definite scheme of national development? How can the major highway system be extended intelligently unless it is known how much money is to be available for it and where the future centers of population and industry are likely to be? How can the needs of the people for transportation—by air, highway, rail, and water—be intelligently met without a coordinated effort to avoid useless duplication of services? How can the natural resources of the Nation be conserved without an intensive study of means to check the present wasteful uses of them? At the session of the City Planning Division on January 18, 1934, during the Society's Annual Meeting in New York, these various phases of the subject were discussed in a symposium of papers, here presented in brief.

Aiding Emergency Construction

By Carey H. Brown
Member American Society of Civil Engineers
Acting Chairman, Technical Board of Review, Public Works Administration, Washington, D.C.



Band Shell in a Public Park Being Built Under a PWA Allotment

Clay Center, Kans., January 1934

ALTHOUGH the desirability of building public works during times of depression of private industry had been talked of for years, the country was in general quite unprepared for such a program when it was launched through the PWA as a part of the "New Deal." This unpreparedness was due to lack of planning for comprehensive physical development. The deficiency has been apparent in Federal, state, and municipal governments alike, although the Federal Government seems to have been better prepared than the states and municipalities. The more prompt response of Federal agencies is no doubt partly due to the fact that they undertake no obligation for repayment as do states and municipalities which seek allocations. Although this consideration to some extent refutes the charge of relative unpreparedness on the part of local governmental agencies, it is necessary only to hark back to the work relief programs of the past two or three years to see that the cities were quite generally unprepared. Men were assigned to the raking of leaves and to other perfunctory tasks, equivalent, in terms of benefit to the community and as a contribution to recovery, to the proverbial taking in of one another's washing. Only through the wasteful experience of these years have they acquired some realization of the necessity of planning to secure the maximum of permanent benefit from emergency expenditures for public construction.

For some twenty years city planners had advocated the long-term planning and programming of public improvements. As a result of their efforts, plans had been prepared for a number of cities, for several regions, and, in incomplete fashion, for a few states. As to Federal activities, the Federal Employment Stabilization Board was set up a few years ago, not so much for the purpose of making a national plan as to tabulate and program the improvements proposed by various Federal departments, each in accordance with its own ideas of national development.

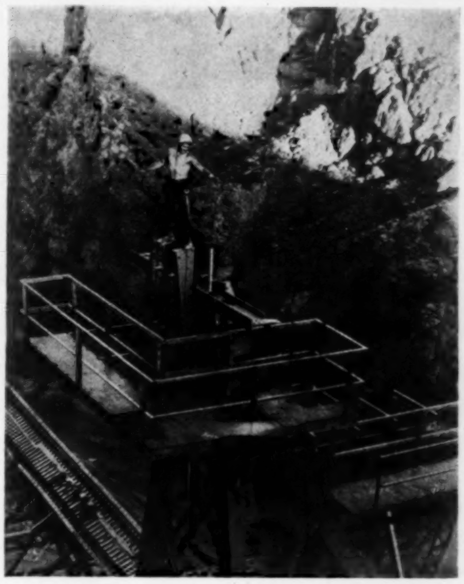
The presidential proponent of the employment stabilization program was unwilling or unable to make it further the very purpose for which it had been organized, that is, to fill up the trough in public works construction. However, the experience of a year or two of depression produced a reaction from the desultory and deadly work-relief system and led, as one of the first manifestations of a new hope, to the formation of the so-called Trade Recovery Committees, in which members of the Society played so large a part. The trade recovery program undoubtedly played a large part in the development of the present Public Works Program. These committee activities resulted in widespread consideration of public works projects of various types, and when such consideration led to the preparation of definite plans for construction and financing, these projects were ready for prompt submission to the PWA when it was organized.

One of the greatest difficulties in the path of planning, either "city planning" as usually thought of, or public works programming as sponsored by the trade recovery group, is the apparent reluctance of states and municipalities to consider any plan that extends very far into the future. Probably the people are so accustomed to political upheavals and changes of policy that long-term planning seems futile. Furthermore, there is a fear that the planner's objective is to foist upon an unsuspecting community the expensive and impractical schemes of a visionary. City planners realize the existence of this feeling and the necessity for overcoming it by greater frankness and publicity as to exactly what they propose.

Development of a physical plan by no means completes the planning task. The development of a long-term financial program is quite as important. The activities of the PWA disclose that in many cases, even when a community is prepared with physical plans for the construction of public works, it has no satisfactory program of financing. The financial plan of a city should include careful development of a system of procedure related both to the type of improvement proposed and to the sources of revenue, and involving among other things decisions as to the proper type of financing. That procedure in such matters is far from being generally established on a sound basis, is demonstrated by the experience of the PWA in the examination and attempted reshaping of the financial proposals of various public bodies.

A discussion of the legal difficulties encountered, in the PWA and elsewhere, in the execution of projects in accordance with sound technical plans would lead far afield. Suffice it to say that there is a crying need for better adaptation of legislation and governmental organization to the logical development of public works, as everyone will testify who has attempted to adapt a sewer system to a topography-scorning city line, or who has encountered the multiple layers of government which separately tax, plan, and "improve" many communities.

Supervision of the application of planning in the PWA is lodged in the National Planning Board. The activities of this board have, in general, followed two lines: the stimulation of local planning activities, and the consideration of planning on a national scale. The PWA has required applications submitted by non-Federal agencies to include a statement of the extent to which such proposals conform with city or regional plans. This not only enables the Planning Board to draw conclusions as to the extent to which plans have been determining features, but likewise is of help in determining the merits of the projects themselves. Of course, many communities had never given consideration to the development of local plans or to the creation of a planning agency. Consequently, failure to accord with a plan could not be considered reason for rejection in their case, although where a plan did exist, compliance therewith was naturally a favorable consideration. Unfortunately, no complete analysis of the bearing of city plans on the non-Federal program of the PWA is available, but the relationship between the degree of preparedness of the cities and the rate of progress of the program is obvious.



Atop the Cableway Tower on the Nevada Side of Boulder Dam

The seven months' existence of the PWA has naturally afforded scant opportunity to develop a structure approximating the lofty designation, "national plan." The size of this problem indicates that it should be separated into units such as are suggested by the subjects into which this symposium is divided. Yet the PWA has made a far greater advance in certain phases of national planning that has ever heretofore been made. For example, establishment of the Soil Erosion Division of the Department of the Interior, with funds to construct demonstrational projects for preventing or counteracting the stupendous waste of farm lands by erosion, marks the beginning of an activity of the greatest importance. The recent allocation of funds to the Surplus Relief Corporation for the acquisition of submarginal lands indicates another new national policy. Also, the development of subsistence homesteads, specifically provided for under the Recovery Act, is to furnish a new type of community life which, coupled with other changes now taking place, will have far-reaching effects on the physical development of the Nation.

Besides the National Planning Board, the Mississippi Valley Committee of the Public Works Administration has certain planning functions. The activities of this committee relate to projects of flood control, navigation, hydro-electric power development, irrigation, forestry, and soil erosion within the drainage area of the Mississippi River. It not only passes on specific projects submitted for PWA allotments but also is concerned with the development of definite plans and policies relating to water conservation and control in the great central region of the country.

Through these various organizations, land planning on a national scale has developed to a far greater extent than ever before. Disappearance of the frontier marks the end of the period of land exploitation and points to the immediate necessity for comprehensive policies of conservation and land planning.

As far as the cities are concerned, the frontier has not yet disappeared; in fact they are probably destined to remain in the period of exploitation for some time to come. The suburbs provide frontiers for residence purposes, and business also continues to move outward. The greatest difficulty in logical municipal development lies in this tendency to abandon property, together with the utilities and improvements that serve it, and to move out to some residential or commercial frontier where there is less competition and more fresh air, thus creating a demand for further expenditures by the municipality to provide the necessary additional services and improvements.

There seems to be no complete solution to this problem. The zoning of property for appropriate use, the development of open spaces either surrounding the city or within it, the rehabilitation of blighted areas by opening new streets or by other improvements, the control of subdivisions and of the extension of utilities—all have a place. Coordination of the tax assessment system with zoning and abandonment of the horse-and-buggy-age policy of graduating assessments on the basis of distance from the center of the city are all-important in this respect. There is no valid reason why assessors should continue to place high tax values and consequent high fixed charges on close-in, decadent residential property while the outlying areas, which are in fact most favored and of the greatest value, are assessed at a relatively low figure. Based in part on high fixed charges, to which the assessor is a party, and in part on the mistaken theory that land values can increase indefinitely, owners expect inordinate prices for close-in but now blighted property. I can see no solution of the blighted-area problem while this attitude persists.

This is the root of a most serious difficulty in the development of suitable projects under the Housing Division of the PWA, namely, the inability to combine low-cost housing with slum clearance. Slum land is generally priced so high that it is absolutely out of reach for the only purpose for which it is usable.

The development of plans—city, regional, state, and national—would seem to afford the most effective means of combating "pork barrel" and "log-rolling" methods of allocating public improvements. Planners and plans necessarily have weaknesses; but the set-up of a comprehensive and coordinated program constitutes the best guide for the selection of the most worthy and most needed projects, under either emergency or normal conditions. The past few years especially have indicated the great necessity for definite plans to follow. During the early part of this period there was an almost complete diversion of funds from the normal channels of public works activity to relief. But through the PWA and the CWA a major part of these funds has now been turned back into the channels of public improvement in those communities which by planning are prepared to devote these emergency funds to projects of permanent value.

Public works necessarily cost more than direct relief. The latter can be increased little, if any, beyond what is needed for bare necessities. It cannot therefore afford the surplus buying power required for real recovery. One community cannot "go it alone" in substituting public works for relief; but on a national scale the practicability of such substitution has been demonstrated.

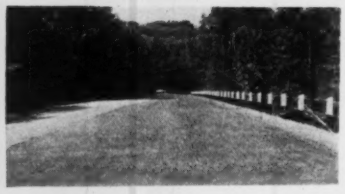
A sequel to the execution of public works programs, or in fact to the accomplishment of any type of spending as a means of hastening recovery, is the rapid amortization of debts when prosperity returns. Private and municipal credit for construction was so over-extended when the need for stimulation arrived that in the period of greatest need no funds were available from the usual sources. Fortunately, the Federal Government took advantage of good times to decrease its debt, and when recovery has been accomplished, it must resume the task of amortization. The inability of cities to develop more comprehensive programs at the present time is due to exhaustion of their credit during fat years, a procedure entirely contrary to the theory of stabilization by public construction.

Experience acquired since 1929 will undoubtedly permanently affect the outlook and activities of the engineering profession. Planning in the fields of engineering, finance, law, and administration must play a larger part in the scheme of things. To be effective, the doctrine of advance planning of public works must be firmly imbedded in governmental organization and in the public mind. This field of work offers increasing opportunities for the engineering profession.

Developing a Major Highway System

By E. W. JAMES

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
CHIEF, DIVISION OF HIGHWAY TRANSPORT, U.S. BUREAU OF PUBLIC ROADS, DEPARTMENT OF AGRICULTURE, WASHINGTON, D.C.



DANIEL WEBSTER HIGHWAY
Federal-Aid Project Between Meredith and Ashland, N.H.

IN any scheme of national planning broad enough to cover the major items of public expenditure, highway construction will certainly be included. Just how this is likely to be effected depends on many things, and a free exploration of the possibilities would go far beyond the scope of this article. It will be interesting, however, to consider one phase of national planning—that involving the general plan of a highway system.

What is to be the scope of national planning? What is in mind at this particular time? How far is it expected that deliberate preliminary planning will be injected into the scheme of government administration? Then the subject might be pursued further so as to consider how far national planning might be carried with beneficial results on the road system and its administration.

To answer the first query is exceedingly difficult. Undoubtedly today an experiment is being made and certain lines of direction are being tested for future governmental operation. It is quite impossible to fix any definite limit for this trend, since it will depend on the effects of trials now being made in various directions. But the several ventures now in hand may be discussed and their effects on the national highway system considered.

At the present time the following enterprises and undertakings are more or less closely identified with the concept of national planning: (1) balancing of budgets, national, state, and local; (2) limitation of the use of land, the idea back of the Agricultural Adjustment Administration, which may have considerable effect on the highway system; (3) intensive regional development, such as that contemplated under the Tennessee Valley Authority, and possibly other enterprises of a similar type; and (4) establishment of agricultural-industrial combination centers, which are exemplified by the subsistence homestead plan.

The balancing of budgets may intimately affect major-road planning. There are two general methods of balancing budgets. One consists in estimating all items of income, pooling them, and appropriating definite sums for specific purposes. Errors in the estimates for the several items of income are likely to offset each other, at least in part, and the probable error in the total is thereby reduced, thus assuring, within the limits of the balanced errors, that there will be sufficient funds to carry out the appropriation program. The other method is to assign to certain general projects, such as education, public works, government, and public services and benefits, the proceeds of certain definite taxes. Each tax item is estimated separately, and errors do not offset each other. There might conceivably be a shortage in the income for the educational program, and a surplus in that for public works. It is not necessary here to discuss the relative merits of the two budgetary systems. Today administrative governmental units are using both methods, usually in combination. In both, the funds that will be available for road construction, betterment, and maintenance are definitely known in advance, and highway work must proceed at a pace strictly in accord with the available funds.

In the Federal-aid Highway Act of 1921 provision was made for laying out a correlated system of highways throughout the United States, which should comprise not to exceed 7 per cent of the total mileage of public roads in each state. This percentage seems to have been used by those who drafted the legislation because in those states having the least total mileage of public roads, such as Nevada and Arizona, it would make it possible to provide a road across the state in two general directions, north and south and east and west. The mileages approved for construction with Federal-aid funds under this law from 1922 to 1933, inclusive, are shown in Table I.

PULGA BRIDGE OVER NORTH FORK OF FEATHER RIVER, CALIFORNIA
Part of Road from Oroville to Quincy, Butte County, Crosses Over Western Pacific Railroad

TABLE I. FEDERAL-AID HIGHWAY MILEAGE ANNUALLY APPROVED FOR CONSTRUCTION

YEAR	MILES	YEAR	MILES
1922	33,359	1928	188,016
1923	168,618	1929	189,851
1924	174,689	1930	193,652
1925	179,680	1931	198,968
1926	184,161	1932	205,025
1927	187,034	1933	207,194

During the first years that this Federal-aid improvement program was under way, it was relatively simple in most states to select practically all this limited mileage by studying the distribution of population in urban centers and the total tonnage of agricultural produce by counties. These data indicated the points which should preferably be joined and the relative importance of the intervening territory.

No thought was given, or needed to be given under the circumstances, to speed of construction. Except in a few state systems, the mileage of connected highway in the United States was relatively small. The growing demand of the motoring public for improved roads and the general need for such roads made it unlikely in the early years of construction that any serious error would be made in selecting road projects. The funds to be spent each year were never known in advance, since the program was entirely dependent on the money made available in the several states.

From the start an effort was made to correlate construction so that the areas most advanced economically would be considered first and so that, as far as possible, continuous and connected routes would be improved. Under a definite budgetary policy, with the amount of the available funds definitely fixed each year and known in advance, it will be necessary to plan construction programs more carefully and with due regard to the requirements of the whole national plan.

LAND-USE LIMITATION AFFECTS HIGHWAY CONSTRUCTION

This national plan will include a limitation on the use of land in certain less desirable areas and, in contrast, intensive development by either regional or more localized planning in other areas. Obviously, limitations on the use of land will lessen the necessity for highway extension in the areas concerned, and there will be a greater need for highway extension and improvement in regions of intensive use.

Throughout the states of Kentucky, Virginia, Tennessee, North Carolina, Mississippi, Alabama, and Georgia the road development now projected, as exemplified in the Federal-aid System, is practically the same. An intensified development in the Tennessee Valley and a possible abandonment of lands elsewhere in the states involved will require a change in this arrangement. This is a case where planinng will compel a change in the previous scheme. New economic demands may be expected where they were previously absent, and they will constitute a first call on whatever work the highway budget permits.

Exactly the same reasoning leads to the conclusion that in smaller areas to which intensive planning is applied, as in the case of subsistence homesteads, there will be an increased urge toward the improvement of local roads. These smaller areas will constitute centers for the general countryside, and it will probably be necessary to serve them with main roads. This will call for certain definite road work dependent on a phase of national planning that the highway engineer will not control.

NEW POPULATION CENTERS REQUIRE HIGHWAYS

Changes in the significance of regional areas and increased or diminished demand for roads will lie with other agencies, and the conclusion seems clear that the highway administration will have to become more centralized and its relations with other governmental administrative agencies more closely correlated than heretofore.

Such developments as those mentioned will necessitate additions to the primary road system and probably will change substantially the importance of feeder roads in certain areas. The selection and development of hydroelectric power sites and the location of industrial centers, with their tributary subsistence homestead areas, may alter the entire highway pattern of a large community. It will be necessary for the highway engineer immediately to recognize these alterations in his annual road-building program. This factor together with that of definitely limited funds will undoubtedly result in a quite different concentration of expenditure from that which has been followed during a period of widespread highway extension.

Areas taken out of cultivation will undoubtedly lose population, and there will be a corresponding decrease in the need for the improvement of local roads. It is conceivable that large areas may be reforested, and in such areas for many years there will be a minimum demand for local roads; but on the other hand there will be a correspondingly greater need for local secondary or feeder roads in the intensively developed areas.

Some idea of the extent of present marginal lands may be obtained from the fact that the first of such areas to be surveyed comprises several belts aggregating over a quarter of a million square miles. It is probable that of all the areas so surveyed a very large part will be rejected for purposes of cultivation. In some states, in the semi-arid regions, the effect on the road system will be considerable.

In any general scheme for national planning it is probable that serious adjustments will have to be made in the levying of taxes. How far this may go cannot be foreseen. The committee on a model tax law of the

National Tax Association has been working for years and so far has made little impression on the chaotic system of taxation prevailing throughout the United States. In many of the states there are hundreds of separate taxing authorities levying a score or more of different kinds of taxes. It is to be hoped that when national planning attacks this serious and fundamental problem some definite set of principles will be developed that will produce adequate revenue and distribute that revenue through state and local budgets as nearly in accordance with the benefits received as possible. When national planning has accomplished its proper ends with respect to the tax system there will be no longer any diversion of revenues derived from motor vehicle users to miscellaneous purposes, and the proper share of land taxes for local road requirements will be established on a rational basis.

National planning will conceivably have to consider the correlation of the entire transportation system, including the railroads, the highways, and the inland waterways. This problem today is one of the most intricate and perplexing of any confronting us, and the financial interests involved are enormous.

It is practically impossible to determine accurately unit costs by any of these three major mediums of transportation; but certainly a solution will not be reached until sufficiently reliable data are obtainable for deciding under what set of conditions it is most economical to haul by highway, railroad, or water. This problem opens a vast field for investigation. In any adequate national planning it must be thoroughly explored in order to develop a combination which will meet the requirements of modern business in the most economical way possible.

CENTRALIZATION OF HIGHWAY AUTHORITY

Again, because of the tax problem and the transportation problem in national planning, a greater centralization of authority will be required, for it is obviously impossible to handle these matters locally and have them fit snugly into any national plan. Finally, if the first steps in national planning are successful it may become possible to approach the highly controversial subject of local government. A large part of the country is organized administratively into small counties to meet the convenience of an era of horse-drawn traffic. Now motor roads and the old county organization affect road administration everywhere. As far as highways are concerned, this detail has already received due attention and has been the subject of positive action in some states. The success of a centralized state road administration is being watched with deep interest in states like North Carolina, Virginia, Pennsylvania, and Michigan, where adjustments have been made or are in progress of realization. This fact again must be recognized as probably emphasizing the drift toward centralization in the road administrations of the states throughout the Nation.

THE BASIC PROBLEM

To summarize, a policy of sound national planning should stabilize the available road funds and probably eliminate unusual construction peaks. It will make necessary some readjustments and additions in primary routes and probably a very considerable change in the distribution of local roads and in the demand for them. Once for all, it should simplify and rationalize the whole system of taxation and favorably affect both local road and state road resources. Also, it should end whatever controversy exists between the proponents of the principal forms of transportation and establish all of them on a sound economic basis. Eventually it will lead without doubt to a greater and greater degree of centralization of highway administration.

Coordinating Transportation Facilities

By C. O. SHERRILL

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
FORMERLY CITY MANAGER OF CINCINNATI, OHIO

A TRUCK AND TRAILER UNIT
Courtesy Kroger Grocery and Baking Company

A GREAT national effort is now being made to correct the abuses that have grown up in the commercial and industrial life of the country due to a lack of cooperation and coordination among competing agencies of production and distribution. This failure to work out and adopt some sound form of national planning is due to many causes, of which perhaps the most important have been the intense individualism dominant in American character and the arbitrary restrictions placed on cooperative action among competitors by the anti-trust laws. These laws were designed to protect the weak industries from the strong, and the public from unfair combinations leading to burdensome monopolies. In many cases these restrictive laws allowed unfair practices to grow up and had an effect diametrically opposed to that which was intended.

In no field of national economy has there been a greater need for sound planning than in the transportation system, nor has there been anywhere a more complete lack of development according to plan. Waterways were improved in the early part of the nineteenth century as an advance over the poor roads and trails that were used by horse-drawn vehicles. Later, railways were built as a still better means of transportation. They largely supplanted the inland waterways until the last two decades, when a considerable revival of water-borne traffic took place. This was largely because of the World War, during which the railroads were unable to meet traffic demands because of inadequate facilities.

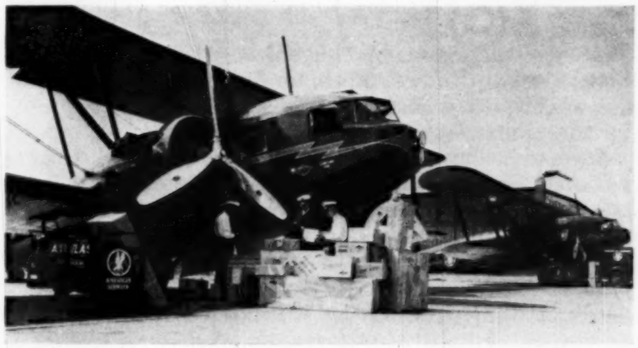
Although the first canal, the Erie, was built only four years before the first railroad, the Baltimore and Ohio, yet the era of canal supremacy continued down to the seventies. The period of railroad development extended from 1850 to about 1890, during which time water transport was almost destroyed, partly by the greater efficiency of railroad transportation, but to a considerable extent by the discriminatory rates given by railroads to competing points on water routes at the expense of points not on such routes. Today an extensive system of paved highways reaches every town in the country and extends into 45,000 communities not served by other means of transportation. These highways carry a constantly increasing burden of freight and passenger traffic, but they have been developed piecemeal and with little thought of their relation to railways and waterways.

AVOIDABLE MISTAKES

If there had been national planning of transportation systems, the old would have been utilized to its full capacity and the new would have been developed in the most economical manner to extend and supplement existing facilities rather than to duplicate and destroy them. Much waterway improvement never would have been undertaken where it proved to be unduly expensive and unnecessary as a duplication of railroad and highway facilities.

Many waterway projects have been carried out by Congress against the recommendations of the U.S. Army Engineers, solely for political purposes and because communities wanted the waterways to use as a club over the heads of the railroads to secure low freight rates, with no thought of actually using the waterways for traffic. A recent important case in point is the development of the Missouri River above St. Louis, which was adopted by Congress notwithstanding the positive recommendation of the Corps of Engineers against it as being economically unsound. All such political expenditures are monumental instances of lack of planning. Nothing could be more unsound than the improvement of waterways solely to control railroad freight rates, nor is there any longer necessity for such a policy, since the railroads no longer have the monopoly they had before highway transportation became such an effective competitor.

With the invention of the internal combustion engine and its application to highway vehicles, a new era in highway transportation started around the year 1900, when there were only 8,000 passenger cars registered in the entire United States. In 1904 there were only 410 trucks in use. From this modest beginning, the number of motor vehicles in use grew to more than 22,000,000 passenger cars and 3,500,000 trucks in 1933.



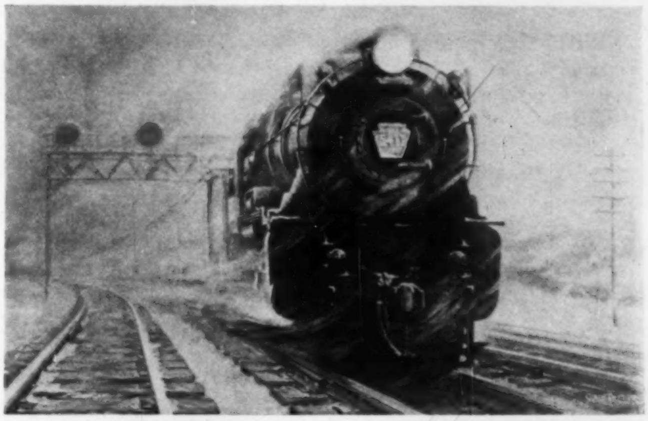
Courtesy American Airways, Inc.

Freight and Express Being Loaded at Airport

Twin Motored Plane Capable of Transporting 4,000 Lb of Freight or 15 Passengers and 1,000 Lb of Freight, Has Cruising Speed of 145 mph and Top Speed of 165 mph

RAILROADS' ATTITUDE DESTRUCTIVE, NOT CONSTRUCTIVE

Although the railroads formed the main part of the national transportation system for a long time before the advent of the motor car, yet in all those 30 years of motor vehicle increase, railroad executives peacefully slept, tied to their rails, while their giant competitor grew and developed in every direction. The railroad executives gave no thought to devising ways and means of taking the lead in the adoption of these new appliances so as to do a more perfect job of transportation. It was only when highway transportation grew in volume until it became a serious competitor of both passenger and freight traffic by rail that they began to show signs of awakening. Even then they did not utilize this new, flexible, and highly serviceable means of transportation, but contented themselves with efforts to harass and destroy it by propaganda and expensive lobbying in the national and state legislatures. Finally a few of the more progressive railroad leaders realized that highway transportation is here to stay and took belated steps to tie the motor vehicle and the railroad together to form a real transportation system. Unfortunately this experiment, as now conducted, appears to be aimed at the destruction of the highway carriers as a practical and economical means of transportation for the shipping public, rather than at the building up of a more flexible and cheaper system of transportation using all the facilities that may be required.



Courtesy Pennsylvania Railroad

A Fast Passenger Train on the Pennsylvania Railroad

Speeds of 75 and 80 Miles per Hour on Straightaway Are Attained. Day Coaches Seat 80; Pullmans Accommodate 26. An Example of Low-Cost Mass Transportation Over Long Distances

Sound planning would prevent such short-sighted practices and would indicate the proper field for railroads, waterways, highways, airways, and pipe lines, allocating to each the class of traffic best handled by it. It should be kept constantly in mind that the factor of distribution cost throws a tremendous burden on both producer and consumer and that the major part of this cost is for transportation. The slogan, "The farmer receives what the consumer pays, less the cost of distribution," emphasizes the fact that waste in distribution must be eliminated. Transportation must be furnished at the lowest possible cost if the farmer is to receive the most for his produce and if the consumer is to pay the least for his purchases.

In transportation the one sound and fundamental principle to which all are officially committed is that stated in the Atterbury-Swayne report of the Joint Committee of Railroad Presidents and Highway Users, as follows:

> The public is entitled to the benefit of the most economical and efficient means of transportation by any instrumentalities of

> transportation which may be suited to such purpose, and no legislation should be enacted which has for its purpose the stifling of any legitimate form of transportation. The supreme test must always be the interest of the public. The public's right to the selection of the agency of transportation which it wants and which it finds most useful must be respected.

With this principle as an initial reference point, a national plan should be prepared, not to save the railways, or to develop the highways, airways, waterways, pipe lines or other means of transportation, but to give to the people throughout the United States the best, most economical, and most convenient means of moving passengers and freight at the lowest possible cost. Too long has thinking been in terms of roads, railways, rivers, canals. Attention should be turned to the real problem to be solved, that is, to the service to be performed—the work to be done for the consuming public. Thinking should be in terms of what the people want and need rather than in terms of what is best for the appliances and agencies available to do the job. Instead of making wooden nutmegs and then trying to persuade the public to buy them, let us find out what the public actually wants and how best to furnish it.

Without question the railway is the best and cheapest agency for the movement of long-haul heavy freight and for long-distance low-cost passenger travel. The motor vehicle is supreme for short-haul freight and passenger service and as a railroad feeder. The waterway is best and cheapest for low-value freight in bulk, where speed is not of importance. The airplane is supreme for emergency, high-speed movement of passengers and light-weight, high-value parcels, especially for long distances. These principles should be kept always in mind in the effort to prepare a sound national plan for the transportation system. Every agency should be used to the extent that it best serves the purpose.

A TRANSPORTATION PLANNING COMMISSION NEEDED

In view of the present chaotic condition, which has been briefly outlined, and the responsibility now assumed by the Government for this condition, a permanent commission should be created by Congress to develop and maintain a comprehensive plan for a national transportation system in the United States, designed to give the public the best and cheapest transportation in time of peace and adequate facilities in time of war, using all means available to this end. Such a commission should number among its members outstanding representatives of railroad engineers, waterway engineers, highway engineers, farmers, consumers, and shippers.

Among the many subjects that might be profitably studied by such a commission are:

1. Equitable conditions for competing forms of transportation, to be secured either by reducing the existing restrictive regulations or by regulating unregulated agencies, taking care not to thereby increase transportation cost.
2. Fair methods and amounts of taxation for the various kinds of transportation.
3. Uniform regulations as to dimensions and loads of highway vehicles on Government-aided highways to ensure safety both to the highway user and to the highway structure.
4. Types, widths, and principles of location for highways in the state highway systems that are aided by funds from the National Government.
5. The proper relation between competing lines and systems of railroads, with a view to eliminating unnecessary burdens of investment and operating overhead by regional consolidation or otherwise.
6. Consideration of railway lines, particularly branch lines, that should be eliminated or replaced by highway transportation. In this connection, the Connecticut Commission, appointed in 1932 by the governor of the state, determined that not less than 2,000 miles of railway feeder lines in New England could be eliminated with a saving in investment burden of approximately $200,000,000.
7. Sound principles that should govern waterway use and development.
8. Principles of joint railway, waterway, and highway rates and operations.
9. Correction of the existing unplanned, cumbersome railroad rate structure by the development of a new system based on actual line haulage and terminal costs, and actual service rendered.
10. Abandonment of freight yards in expensive municipal areas and the substitution of suburban assembly yards, collection to be by trucks in and around metropolitan areas.
11. Development of the shipment by rail of truck bodies, semi-trailer bodies, and complete semi-trailers on wheels, to secure the lowest possible haulage cost by the joint use of highway and railway.

In conclusion, it may be stated that in no field of the national life is there a greater opportunity than in the transportation system for a sound program of national planning to improve the service to the consuming public and to reduce the costs of such service. By thus reducing waste in distribution, a material rise in the national standard of living will be attained.

Conserving Natural Resources

By ARTHUR E. MORGAN
MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
DIRECTOR, TENNESSEE VALLEY AUTHORITY, KNOXVILLE, TENN.

A VARIETY of issues is covered by the work of the Tennessee Valley Authority, one of which is conservation by the best use of national resources. The purpose of President Roosevelt in advising the establishment of the Tennessee Valley Authority was to provide a limited area in which various elements of social and economic planning might be worked out before being applied to the United States as a whole. It is well to have mistakes made on a small scale rather than on a large one, and to work out a proposed development experimentally before there is any widespread application of it. In a good many cases the national application of a policy is necessary to begin with. For instance, the fiscal policy must be national; the railroad policy must be almost national; the NRA program must be national; the relations with foreign nations must be national.

On the other hand, there are some problems which can very well be worked out in a regional way. For instance, there is the matter of power use. The President has expressed himself as wishing somewhere to have a yardstick, as he calls it, by which to make a practical comparison between public ownership and private enterprise in the transmission and distribution of power. If that can be worked out in a limited area, a picture of the relative merits of the two methods can be obtained without at once plunging the country into any large-scale project of public ownership.

COORDINATING HYDRO-ELECTRIC POWER ON TENNESSEE RIVER

In the future there probably will be fairly keen competition between the various sources of electric power—that developed from water, steam, internal combustion engines, and possibly a few other minor sources. It is rather popular in utility fields to say that the day of water power is past, that henceforth steam power will be cheaper and more effective. This criticism came from the same sources some 10 or 12 years ago; but the development of water power has continued.

Soil Erosion in an Advanced Stage, Alabama
Boys of the Civilian Conservation Corps Beginning Preventative Work

When the law creating the Tennessee Valley Authority was in process of enactment, the statement was made repeatedly that it was almost a crime to undertake more water power developments because the country already had an excess of power. Yet within the few months that the Tennessee Valley Authority has been in operation one of its functions has been to check the development of water power in the valley by private enterprise, since it was in an area where such a development would conflict with the plans of the Authority and create chaos instead of order. There has been strong pressure in recent months for further development of water power by private initiative, and at the same time there has been increased criticism of such further development.

From the standpoint of the conservation of natural resources, the Tennessee Valley is a section where planned development ought to supersede independent and unrelated efforts. The drainage area of the Tennessee River, about 40,000 sq miles, consists of two main features, the river itself, on which there are numerous water power developments and possibilities, and its tributaries. On the Tennessee River itself there are excellent power sites but very little possibility for storage. For instance, the Wilson Dam at Muscle Shoals can develop power only as the water flows in the river. There is almost no storage. In a very dry season the possible power development there would drop down to about 25,000 kw and in a wet winter would rise to 600,000 kw. There is a variation of almost 25 times between the low-water and the high-water capacity for power. That same variation is true of all the existing and possible plants along the Tennessee River, with a total fall of about 700 ft. On the tributaries of the Tennessee the situation is very different. Some sites have potentialities for immense storage, for two years or more, and for almost complete regulation except in extreme cycles.

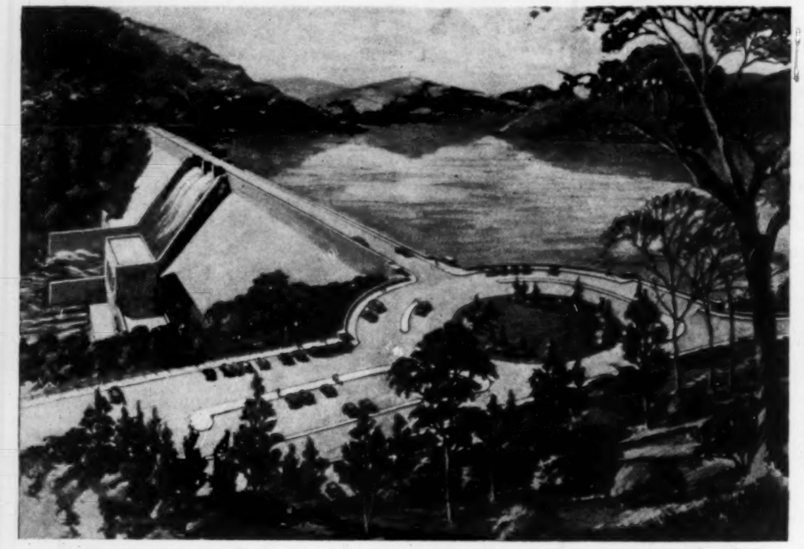
Retarding Soil Erosion by Check Dams
A Civilian Conservation Corps Activity

Up to the present time these developments have been independent of one another. Take, for example, one which produces power for aluminum manufacture. The plant is run as the power is needed. If there are large orders in the winter a large amount of power is used at that season, and similarly, if business declines in the summer, a small use of power results. Thus the supply of water to the plants farther down the river, which are under different ownership, is quite independent of their need. At the up-river plant the flow of water is regulated only by the needs of that plant, not by those of the area generally. Therefore the water that is let out of the reservoir during the months of high water is wasted below.

If all those plants, above and below, could be united under one management the situation would be very different. The Norris Dam, for instance, is being built on Clinch River. It will store water for a year or two. It could store the entire annual flow in a normal year. By operating the Norris Dam power plant on Clinch River and the Wilson Dam power plant at Muscle Shoals as a single unit, the combined power output will be five or six times what it would be for either plant operated alone. This is because the water stored at Norris Dam can be used for about three months in the year to fill up the low spot in the flow curve at Wilson Dam.

If the entire watershed of the Tennessee River is utilized as one unit, then the dams on the headwaters can be used for storage when there is an abundant flow below, and for the generation of power when there is a shortage in the river below. The water that flows through the upper power plant must flow in turn through each power plant below. With full development, that would mean 700 ft of fall, all of which could be utilized for power. With combined use and unified operation over the whole river system, it is probable that electric power might cost only one-half or one-third as much as it does now under scattered ownership and control.

Under separate ownership each of the up-river plants where there is room for storage would have to be built with regard to the income to be derived from it, and the investment for storage would have to be such as would be proper for that unit alone. But if the facilities can be utilized for a plant below, a larger investment is possible. In the best use of that investment, organization, design, and unification are necessary. This kind of economic planning can cut at least in two the cost of hydro-electric power in that region.



T.V.A. ARCHITECT'S DRAWING FOR NORRIS DAM ON CLINCH RIVER
Drawing of an Earlier Design Shown in September 1933 Issue, Page 1

PREVENTION OF SOIL EROSION

There are some problems that are specifically regional—at least they are much more important in some parts of the country than in others. Among those is the problem of soil erosion. In the uplands of the South, it is almost the most critical problem that is facing the people.

When the white man came to this part of the country he found it a region of great soil fertility. Chestnut trees have grown to 100 in. in diameter, and even after the original stand of timber is cut off, if the soil is not entirely gone, a fair second growth of forest will appear. The Tennessee Valley is a rolling area, largely cultivated in small holdings but with the tops of the ridges still in forest. About three-quarters of the population is agricultural, but much of the land formerly cultivated has been abandoned, partly because the soil has been washed away.

A custom, almost a folk way, in this region is to burn over the forested land every year. It is one of the most destructive habits that a people can have. It leads to the destruction of the undergrowth and all the young timber and to the gradual elimination of the forest itself.

As the land is cropped the soil tends to wash off the fields. How much is not known, but it is probable that one or two or even three feet of soil has been washed away from lands farmed for fifty years or more, leaving exposed a subsoil of small nitrogen content and limited phosphate content.

There is no virgin land that is flat. After a hillside is cleared, about four crops can be raised before the soil is washed away, at which time another tract is cleared. To retard and correct this destructive work a land-use survey will be made to determine if possible what land ought to be taken out of cultivation; what part of that in cultivation is fit for plowed crops; and what ought to be planted in sod crops.

Soil erosion relates to power production as well as to agriculture. There are storage reservoirs for power in that region which in ten years have lost half their storage capacity. Because of the limited number of power sites, the available capacity for storage will disappear if erosion continues at this rate. In some sections half the area formerly in cultivation has been destroyed and the remaining half is disappearing at a rapid rate.

One means of checking erosion is to build a series of small timber dams in strips across the forming gullies and to plant the banks around them with various plants whose root systems will consolidate the soil and whose vegetation will catch the eroded material. By the time the timber has rotted away the growth will have formed a thick mat, not easily eroded. Honeysuckle, although a pest in itself, is well adapted for this purpose. Other plants are being sought which will have the additional merit of being agriculturally valuable.

NEW AGRICULTURAL ECONOMY NEEDED

The chief agriculture in the Tennessee Valley region has been the raising of corn, cotton, and tobacco, which is very destructive of the soil, because when the land is first plowed it washes very rapidly. By introducing legumes and grass, which should lay the foundation for profitable dairy farming, the soil may be saved. But it has been found that the region has no commercial organization for that type of agriculture. All such organization is for corn, cotton, and tobacco, so that if another kind of agriculture is introduced markets must be developed for the disposition of the products, and the farmers and merchants must be organized to handle them.

LEGAL RESTRICTION ON USE OF LAND

After this program is fairly well advanced and soil erosion is reduced by, say, two-thirds of what it is now, then it may be time to inaugurate legal restrictions—to require that if a man will not use his land well, that if he allows it to be destroyed, it may be taken away from him and given to some one who will take care of it. If he has 100 acres of land from which the soil is being washed away, perhaps his holding should be cut down to 50 acres. Perhaps in this region the ownership of the land should depend on the proper use of it, which means the planting of proper crops; terrace farming, which will very often stop the erosion; and the taking out of cultivation entirely of land unfit for that purpose.

There are many other natural resources that need proper regulation. The forests are being destroyed for their raw materials, whereas they ought to be kept for continuous use, the new growth being encouraged to take the place of the trees cut. Coal can be more productively used, as well as other mineral resources, especially those employed in ceramics. Means to control the use and development of these resources are being considered, so that instead of waste there will be the maximum income for the present generation and security for the next.

Committees of the Structural Division Report

Active Groups Studying Bridge Floors, Concrete Slab, and Wind Bracing Render Accounts of Their Work During Annual Meeting of the Society

Committee on Bridge Floors

Charged with the duty of collecting and correlating information on various types of highway bridge floors, the Committee on Bridge Floors submitted its first progress report to the Structural Division on January 18, 1934, during the Annual Meeting of the Society. If feasible, it is the purpose of the committee to produce a Manual that will be of assistance to bridge engineers in selecting practical and economical floors. The committee has carried its work to the point of determining a complete detailed outline of the subject, and has prepared a draft of the first section of its report.

In all, the work to be done has been divided into 11 sections. Section 1 will deal with the general features of the floor, such as the widths of the various passageways; types of curbs; shape of cross section; permissible grades; provisions for drainage; expansion, construction, and deflection joints; and street railway tracks. Section 2 will include the materials available for use in floors, such as timber, asphalt, concrete, steel, aluminum, brick, granite, and rubber. Section 3 will contain data on the characteristics of an ideal wearing surface and suitable available types; and Section 4, detailed descriptions of the various types of roadway floors in use. In Section 5 it is proposed to deal with sidewalks and safety walks, and in Section 6, with curbs. The design of various types of floors is to be taken up in Section 7, and in Section 8, the methods of framing members to support the floor. The relative service to be expected from various types of floors will be the subject of Section 9; and their respective fields of usefulness will be considered in Section 10. Finally, in Section 11 will be found an economic comparison of the various floors, with due regard to the kind of bridge and the span length, and the economics of light and heavy floors.

Although the concrete slab is one of the cheapest and best, it is at the same time one of the heaviest types of floors. As a general rule, the heavy, cheap floor will be indicated for short spans, whereas for long spans a light, more expensive type will represent a saving. It is the expectation of the committee to proceed during this year with the writing of the various sections of the report. The membership of the Committee on Bridge Floors consists of Allston Dana, O. L. Grover, C. A. Melick, H. C. Tammen, and Shortridge Hardesty, Chairman, all Members Am. Soc. C.E.

Concentrated Loads on Slabs

At the request of the Committee on Masonry and Reinforced Concrete of the Structural Division, a member of the committee, Clyde T. Morris, M. Am. Soc. C.E., prepared a Report on Concentrated Loads on Slabs, which constitutes a progress report of the committee. No new data are contained in Mr. Morris's report, but an effort has been made to review the existing information on the subject, to correlate it, and to formulate rules for design that will be safe, economical, and easily applied.

Experimental investigations on slabs supported on two edges were begun in 1912, and more recently the first complete theoretical analysis was made by H. M. Westergaard, M. Am. Soc. C.E. Professor Morris's report indicates a close agreement between experiment and theory, and the rules he formulates will be found useful to designers. Some of the conclusions follow:

When loads are not nearer to a transverse edge of a slab than about the span length, the effective width of a slab for a single concentrated load may be taken as

$$E = 0.6\,s + 2\,c \quad . \ . \ . \ . \ . \ . \ . \ . \quad [1]$$

in which E equals the effective width, that is, the width parallel to the supports over which a concentrated load may be considered as uniformly distributed, and which will give the same calculated stress in the slab as the maximum stress actually produced by the load; s is the slab span; and c is the diameter of a circular area over which the load is assumed to be applied. For highway truck wheels, the diameter c may be taken as 1 in. for each thousand pounds of load on the wheel.

The increase in moment in one element of a slab caused by loads on another parallel element separated by a distance y, is

$$\text{Percentage of increase} = \frac{100}{1 + 10\left(\frac{y}{s}\right)^2} \quad . \ . \ . \quad [2]$$

When slabs are of less width than about 1.6 times the span length and have unsupported edges, the effective width is given by

$$\left(\frac{e}{E} + 0.78\right)^2 = 3.2\,\frac{b}{s} - \left(\frac{b}{s}\right)^2 + 0.608 \quad . \ . \ . \quad [3]$$

in which e is the effective width of a slab with width b, and E is the effective width of a slab of indefinite width.

When loads are applied closer to an unsupported edge of a slab than about 0.8 of the span length, the effective width may be taken as

$$e = {}^1\!/_2\, e_c + d \quad . \ . \ . \ . \ . \ . \ . \quad [4]$$

in which e_c is the effective width for a central load, and d, the distance from the load to the nearer edge.

The complete report has just been published as a bulletin of the Engineering Experiment Station of Ohio State University. Those interested may obtain copies by writing direct to that source.

Wind Bracing in Tall Buildings

Subcommittee No. 31 of the Structural Division's Committee on Steel rendered its Progress Report No. 4 to the Division on January 18, 1934, during the Annual Meeting of the Society. This subcommittee, composed of Clyde T. Morris, N. A. Richards, Francis P. Witmer, and C. R. Young, Chairman, all Members Am. Soc. C.E., has continued its studies during the past year but they are not yet complete and ready for presentation. Other investigations have been planned and will be carried into effect when the necessary funds are available.

The subcommittee expressed its appreciation of the wide discussion which has been accorded its progress reports and which it will use as a guide for the planning of its future work. It believes that it will be beneficial to give engineers concerned with the bracing of buildings a further opportunity to study and test thoroughly such proposals as have already been made. The work of the committee will continue during 1934, and as soon as practicable another progress report will be released.

New Jersey Approach to the Holland Tunnel

One of the World's Most Heavily Traveled Highways Pays Dividends to Taxpayers

By W. G. Sloan *and* S. Johannesson

Members American Society of Civil Engineers

Respectively State Highway Engineer and Designing Engineer, State Highway Commission, Trenton, N.J.

Technical literature contains rather complete descriptions of the New Jersey approach to the Holland Tunnel—its economics, its planning, and its construction. In 1933 this 13-mile highway carried traffic at the rate of 11,000,000 vehicles per year, and it bids fair to become one of the most heavily traveled routes in the world. Now that this $44,000,000 route is in complete use, it is of interest to determine to what extent it is meeting the requirements estimated for it by its designers. This Messrs. Sloan and Johannesson did in the paper of which this article is an abstract. The original paper was presented before the Highway Division on January 18, 1934, during the Annual Meeting of the Society in New York.

Construction of the Holland Tunnel, carrying vehicular traffic across the Hudson River between New York and New Jersey, was commenced in 1920. It was expected that a heavy traffic would develop when the tunnel was completed and opened, and in anticipation of it, the New Jersey State Highway Commission appointed early in 1923 an Advisory Board, which was charged as follows:

"To study the problems presenting themselves in connection with the expeditious and economical handling of the volume of traffic which will converge to and diverge from the entrance to the vehicular tunnel in Jersey City throughout the zone in which points of congestion due to such traffic may occur; to give consideration not only to the probable character and amount of traffic to be expected at the time of the opening of the tunnel, but also to its future character and amount; to devise plans for handling such probable traffic in accordance with the above, such plans to embrace the location of routes and types of construction; to compile the results of the above work in a report to be furnished to the State Highway Commission."

Before the opening of the Holland Tunnel, all the trans-river vehicular traffic between New York City and the adjacent shore of New Jersey was carried by ferries operating on 15 different routes. Five of these, serving a waterfront about two miles in length, were within the area in which it was expected that the principal tunnel traffic would originate. These five ferry routes terminated in New Jersey at three points, each terminal being about one-half mile from the nearest neighboring terminal (Fig. 1).

At the ferry terminals, the New Jersey shore front, as well as the adjacent land for about one mile westward, is only a few feet above mean high water. But beyond, the land rises abruptly to an elevation of about 100 ft above mean high water, forming a hill which must be surmounted by all vehicular traffic coming from or going to the west and south.

Before the opening of the tunnel, the vehicular traffic that passed through Jersey City was heavy, but of course was much less dense than it is at the present time. In 1922 about 3,850,000 vehicles crossed the Hudson River on the five ferries previously mentioned. However, the traffic across the Hackensack River Bridge was actually greater than that across the Hudson River and amounted to 4,600,000 vehicles in that year.

Elevated Section of Route 25 Across the Passaic and Hackensack Rivers

TRAFFIC DENSITY FORECAST

In the estimates of future traffic contained in its report of August 1923, the Advisory Board properly limited itself to a period of approximately 25 years, because it was expected that any forecast beyond that period would be purely problematical. In fact, it was hazardous to make an intelligent estimate even for a much shorter period, because at that time there had been a recent and rapid increase in the use of motor vehicles, making it difficult to establish the probable normal growth. In addition, the modern development of the state highway system had but recently started; and finally, there was little if any precedent for determining the effect that the opening of the Holland Tunnel would have on traffic volume.

The Advisory Board based its general estimates of future traffic on the assumptions: (1) that the volume would increase with an increase in population; (2) that the number of vehicles registered in the state would increase in such manner that in 1950 there would be 4 persons per vehicle, whereas in 1922 there had been 9.7 persons in the state for each vehicle registered; and (3) that for the so-called metropolitan area of northern New Jersey, the increase in traffic probably would be proportional to the increase in registration.

For the proposed highway approach to the Holland Tunnel, the Advisory Board did not base its conclusions solely on these general estimates because they did not include the abnormal traffic increase expected after the opening of the Holland Tunnel. The main basis for the board's estimate of the traffic on this highway was the ultimate capacity of the Holland Tunnel, 15,640,000 vehicles per annum, which would be reached in 1937, and it was expected that a similar number would be routed over the highway.

CHANGES IN ADVISORY BOARD PLANS

Generally speaking, the highway as constructed follows the route recommended by the Advisory Board (Fig. 1). The principal deviation is at the top of the hill in Jersey City, where the alignment was changed to follow that of the Erie Railroad on account of difficulties in obtaining a right of way on the route suggested by the Advisory Board.

As regards types of structure used, the recommendations of the Advisory Board were generally followed, except at and between the Hackensack and Passaic rivers. At these crossings the use of movable bridges was contemplated, as recommended by the board, and applications were made to the War Department for the necessary permits. The applications were approved, but subject to certain requirements in connection with the bridges on the existing state highway across the two rivers. As it was apparent that these requirements would materially affect the economics of the project, it was decided before proceeding further to make a new study. In this study not only movable bridges and tunnels were considered, but also fixed bridges high enough to permit all water-borne traffic to pass underneath. It was this latter type of construction that was finally adopted after due weight had been given to economic and other considerations.

NEW ROUTE PAYS GOOD DIVIDENDS TO USERS

Until late in the year 1932, when the high-level viaduct was completed, all traffic between Jersey City and Newark and points to the south and west was carried across the Hackensack River on two bridges, one above and one below the location of the new viaduct. The total traffic over these two bridges had increased uniformly from 1923, and in 1932 was 162 per cent above that of 1923. In 1933, however, this traffic was only 59 per cent above that of 1923, the reason being, of course, that a large part of the traffic was diverted to the new highway. It is apparent, therefore, that the new highway is performing one of the important functions for which it was intended, namely, that of relieving the burden on existing heavily congested thoroughfares.

Another purpose of the highway was the expeditious and economical handling of such traffic as would pass over it. It may be proper to consider whether this end has been achieved. The total distance from the Holland Tunnel plaza in Jersey City to the southerly limit of the City of Elizabeth over the roads existing previous to the construction of the new highway was $15^{1}/_{4}$ miles. The new highway has shortened this distance by $2^{1}/_{4}$ miles. Assuming that the cost of vehicle operation is 8 cents per mile per vehicle, exclusive of driver's time, and that the annual traffic is 12,000,000 vehicles, there has been a saving to vehicle owners of $2,160,000 per annum. Over the previous highways the travel time was about 55 min. Over the new highway this has been reduced to 20 min. Assuming a time value of 1 cent per minute per vehicle, the saving on this item is $4,200,000. The total annual saving, therefore, may be estimated at $6,360,000.

Possibly 15 per cent of this saving in vehicle operating cost is enjoyed by vehicles from other states. The saving to the people of New

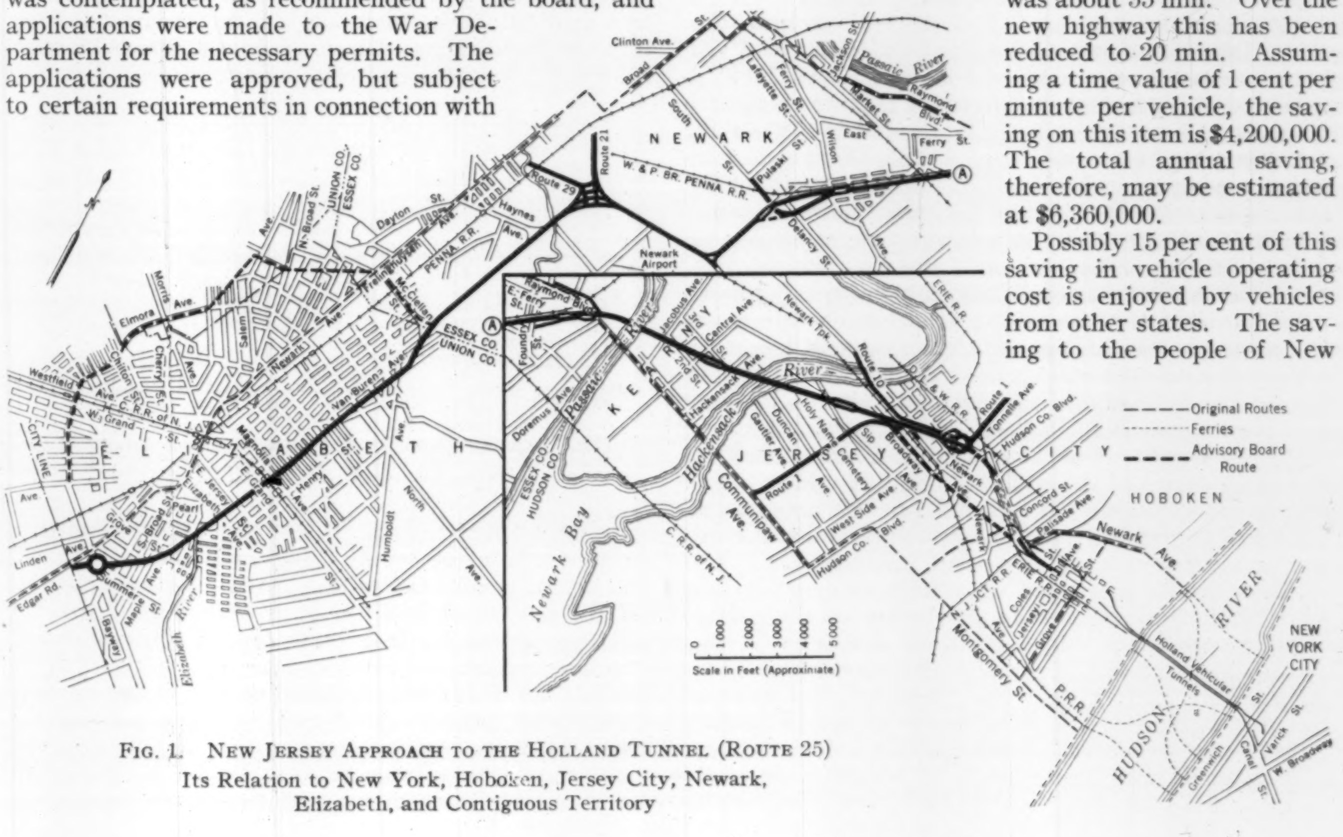


FIG. 1. NEW JERSEY APPROACH TO THE HOLLAND TUNNEL (ROUTE 25)
Its Relation to New York, Hoboken, Jersey City, Newark, Elizabeth, and Contiguous Territory

ROUTE 25 CLEARS PASSAIC AND HACKENSACK RIVER TRAFFIC; JERSEY CITY AND NEW YORK IN BACKGROUND

Jersey, therefore, may be estimated at $5,406,000, which may be considered as the dividend on the investment represented by the cost of the highway. The total cost, including right of way, construction, engineering, and administration, has amounted to $44,000,000, so that the dividend is at the rate of about 12 per cent per annum. It may be added that to all intents and purposes all the money used for the construction of the highway has been or is being collected from motor vehicle registration fees and gasoline taxes.

According to a paper by L. S. Tuttle—"Determination of the Time Saved by Vehicles Using the High-Level Viaduct Between Jersey City and Newark, New Jersey," presented at the annual meeting of the Highway Research Council, in Washington, D.C., in December 1933—there has been an indicated saving of 66,105,000 vehicle minutes per annum by the construction of that part of the new highway between Jersey City and Newark, and it is further indicated that the average time saved per vehicle is 7.1 min. The travel distance over the old route was 4.2 miles, and that over the new highway is 3.7 miles.

On the basis of these assumptions—an operating cost of 8 cents per vehicle mile and a time value of 1 cent per vehicle minute—the money value of the savings may be taken to be $1,141,050, indicating a dividend of $5^1/_2$ per cent per annum on the $20,400,000 invested in the construction of this part of the highway. From the savings should be deducted the additional cost of vehicle operation due to additional rise and fall, but this may be considered as balanced by additional savings at street crossings and is therefore not taken into account.

These figures are based on counts made at a time when traffic was at a minimum owing to the present business conditions. In fact, it is indicated in Mr. Tuttle's paper that the actual traffic probably is about 40 per cent greater than the estimate. Therefore at the present time the dividend on the money invested is actually at the rate of 7.8 per cent.

Because of the present material reduction in traffic density, not only on the highways but also on the Hackensack and Passaic rivers, the delays at the river bridges at the time the survey was made were considerably less than they would be under normal conditions. In fact, the traffic on the Hackensack River, which normally would require some 12,000 openings of the bridge during the year, was so reduced that only about 6,000 openings were made, and a somewhat similar but smaller reduction occurred at the Passaic River.

It is therefore probable that in normal times the indicated saving in travel time of 7.1 min will be about twice that amount. With increased highway traffic it is likely that the dividend on the money invested may be taken to be not less than 10 per cent per annum.

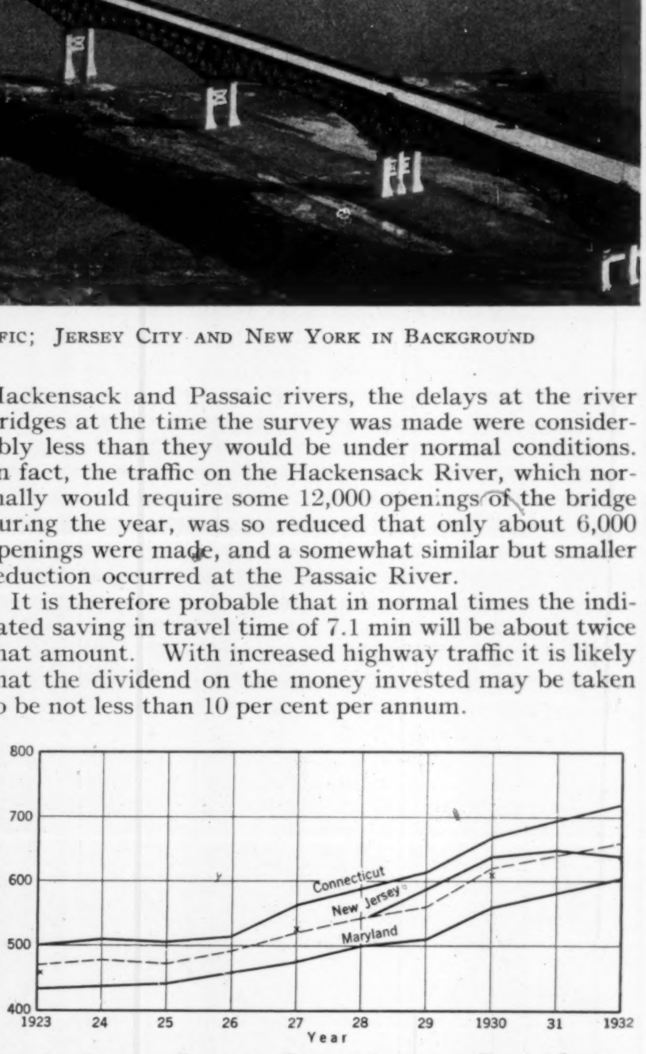


FIG. 2. ANNUAL GASOLINE CONSUMPTION FOR THREE STATES

Crosses Indicate Average Consumption for 21 Other States

It may be of interest to compare the estimates of future traffic made by the Advisory Board in 1923 with the actual conditions as they have developed to date. In the matter of increase of traffic volume, the best evidence would be that presented by the increase of gasoline consumed year by year during the ten-year period, but there was no gasoline tax in the State of New Jersey until the middle of 1927, and consequently there are no available records of the gasoline consumption in the state prior to that time. It is possible, however, to obtain a reasonably accurate estimate of such consumption by means of the records of the states of Connecticut and Maryland, two eastern states that have traffic conditions similar to those of New Jersey, and in which gasoline taxes were levied prior to 1923.

In Fig 2 are shown curves of annual gasoline consumption per motor vehicle in Connecticut and Maryland between 1923 and 1932, as well as the average curve for these two states. It shows also the annual gasoline consumption per vehicle in New Jersey since 1928. It will be seen that the curve of the New Jersey consumption between 1928 and 1932 follows quite closely the average curve for the states of Connecticut and Maryland. It is probable, therefore, that this average curve may be taken to show the gasoline consumption per vehicle in New Jersey between the years 1923 and 1927. As a further check, the average gasoline consumption for 21 other states, for which records are available since 1923, has been computed and is indicated by crosses on Fig. 2. It will be seen that the average of these 21 states follows quite closely the average obtained from the states of Connecticut and Maryland, and therefore it is believed that it is reasonably correct to assume the gasoline consumption in New Jersey prior to 1928 to have been about as shown by the dotted line.

On this basis a curve has been plotted as shown in Fig. 3, which gives the percentage of increase of gasoline consumption per vehicle in New Jersey between the years 1923 and 1932. This curve indicates that while consumption was quite uniform during the years 1923, 1924, and 1925, there was a continued increase from year to year until 1931. The average distance traveled on a gallon of gasoline is uncertain, but assuming it is 12 miles, it would appear that the average distance traveled per vehicle has increased from about 5,600 miles in 1923 to about 7,800 miles per year in 1932.

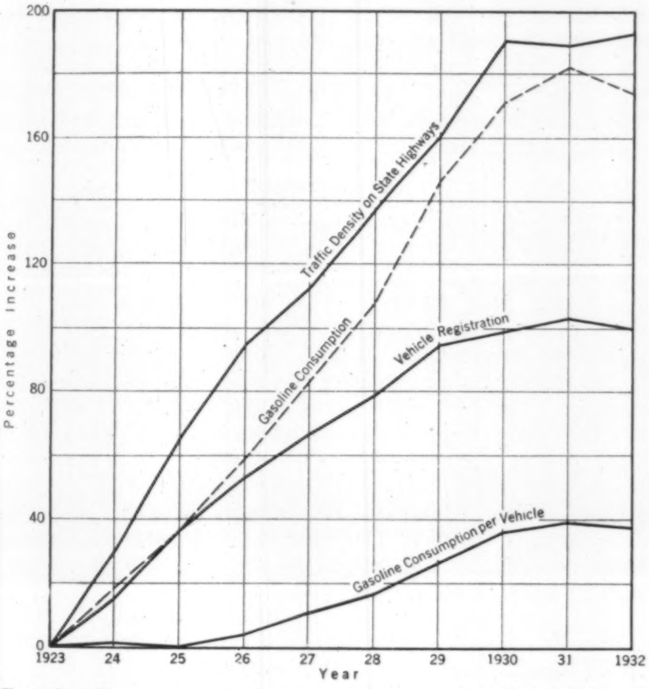


FIG. 3. GASOLINE CONSUMPTION, AUTOMOBILE REGISTRATION, AND TRAFFIC DENSITY IN NEW JERSEY

RAMP CONNECTION TO A SURFACE HIGHWAY, LOOKING TOWARD NEWARK, N.J.

In Fig. 3 is plotted a curve showing the percentage of increase of motor vehicle registration during the ten-year period. The curve shows that the total increase has been 100 per cent since 1923. A curve representing the percentage of increase of total gasoline consumption from year to year is also shown in Fig. 3. It is obtained from the two curves previously mentioned, and it represents in effect the percentage of increase of total traffic volume on all the highways, roads, and streets of the State of New Jersey. It indicates that the total traffic volume has increased about 175 per cent, although registration has increased only 100 per cent.

Finally, another curve in Fig. 3 represents the average percentage of increase of traffic density on eight representative state highways on which traffic counts have been made during the last ten years. This curve indicates that the traffic density on these highways has increased nearly 200 per cent. It is of interest to compare this curve with that representing percentage of increase of gasoline consumption. The total gasoline consumption, divided by the total road mileage, represents the average density of traffic on all roads in New Jersey. As there has been some, but an undetermined increase of total road mileage during the ten-year period, it is apparent that the average increase of density of traffic on all the roads is well below that of the state highways. This condition is largely because the state highways cover the main arteries of traffic between centers of population, but apparently also because a wide, well-paved highway, offering little obstruction to rapid progress, attracts not only the traffic which it would naturally have as a result of its location but also that from more or less parallel roads on which traffic conditions are less satisfactory. It is apparent, therefore, that the improvement of a highway may benefit not only its own normal traffic but also that which normally passes over paralleling roads, because the vehicles that change to the improved road obtain better traveling conditions, and those that remain find less congestion.

Filter Materials for Water and Sewage Works

Committee Report to Sanitary Engineering Division, January 18, 1934, at Society's Annual Meeting

EARLY in the work of the Committee on Filtering Materials for Water and Sewage Works it was felt that the characteristics of the water to be filtered materially influenced the behavior of the filter bed and that possibly a different type or grain size of filter sand might be necessary for waters of different character.

The factors which affect the operation of a filter sand are so variable and of such number that no definite conclusions could be determined without first reducing the number of variables. Also it seemed desirable to attack the problem from the empirical rather than the theoretical angle.

Small glass tube filters had been used successfully at Baltimore, Chicago, and elsewhere. Accordingly, a program of experimental work was developed including a set of eight glass tube filters as the test unit with several sizes of sands in the different filters. [See CIVIL ENGINEERING for December 1931, page 1389.] In order to remove as many variables as possible, the sand was sieved and furnished to cities by a member of the committee, James W. Armstrong, M. Am. Soc. C.E., on behalf of the committee. As many as 14 cities agreed to cooperate in the series of tests.

Early in 1932 the procedure of the experimental work was revised after a number of conferences between interested filter plant operators. New supplies of filter sand were sent out, and a very active program for experimental work has been in progress since that time. Additional cities have become interested and have joined the work, until to date 16 cities have installed sets of glass tube test filters. The entire program has been financed without expense to the Society except a few dollars for express charges on sand shipments and some mileage costs for committee meetings. The results of the program of experimental work have been tabulated and analyzed by Mr. Armstrong, but certain conclusions indicated by the test results diverge from generally accepted practice. There are a number of points on which the members of the committee feel that some additional test work would be desirable to check certain of the tendencies brought out by tests which have been completed. The committee hopes to report these data in some detail within the next few months.

Consideration of materials for sewage filters was divided under two major headings: (1) fine-grained materials; and (2) coarse-grained materials. The first classification has been related to intermittent sand filtration of sewage and to sand beds for sludge dewatering. The second classification has been related to sewage trickling filters.

Reports on these two subjects were presented in 1931 and are now being edited to bring them up to date with regard to new information which has become available during the past two years.

The problems with reference to sewage trickling filter materials relate to: (1) the selection and testing; (2) the grading and placing; (3) the sewage loading to be applied. The problem of selection involves two steps: first the selection of type as between slag, crushed stone, gravel, or other material; and second, the selection of source of supply.

As with water filters, a great many factors affect the results of operation of sewage filters. Furthermore, the information relative to most of the existing trickling filters is incomplete or inexact in many important items. So the results of operation are not as useful as they should be as a basis for judging the relative merits of the various types, gradation, or characteristics of the filter media used in them.

Some comparative data have been published from time to time on the operation of different filter media and are available for a small test filter which has been operated over a period of upwards of two years by the New Jersey Agricultural Experiment Station.

More definite conclusions have been made as the basis for selecting the source of material after the general type has been decided upon. Two major factors enter into the selection of source, aside from cost considerations. One is the relative durability of the material to be obtained, and the other is the preparation of the material to remove fines.

A test for durability has been developed, involving a series of 20 cycles of application of a sodium sulfate test for soundness. A tolerance of not more than 5 per cent of material less than the smallest specified size has been suggested. Rigid inspection and tests of material will be required during construction.

There is considerable evidence that the character of the applied sewage is an important factor in the loading of a trickling filter. Further, there is still a lack of any generally accepted yardstick for measuring the efficiency of operation of trickling filters. Inasmuch as sewage trickling filters are oxidizing elements, the B. O. D. reduction of the sewage by the filter has been used to measure the load on, and the work done by the filter. There is some question as to the effectiveness or completeness of such procedure. Possibly other tests must also be considered. Continued attention to the matter of trickling filter loadings would be desirable.

FINAL REPORT

It is the desire of the committee members to bring the three major lines of study to a reasonable stopping point and to close up the committee work as soon as possible and make final reports. The investigations have extended over a considerable period, since May 1925, and should be brought to an end. The questions involved in the studies are not subject to a final hard and fast conclusion. The new data being brought forth from time to time may modify the conclusions even before the final edition of the reports is completed. It is proposed to submit three reports: one dealing with "Fine-grained Filter Materials for Sewage Works," another dealing with "Sewage Trickling Filter Materials," and a third relating to the results of the program of experimental tests on sands for water filters.

The two reports on sewage filter materials are substantially completed and will be submitted to the Executive Committee shortly. It is expected that the report on the water filter tests will be completed within the next few months.

Respectfully submitted,
WILLIAM E. STANLEY, *Chairman*

James W. Armstrong
W. H. Dittoe
George B. Gascoigne
N. T. Veatch, Jr.

Littoral Drift

An Explanation of Its Action in Denuding and Building Up Ocean Beaches

By J. J. HENNEBIQUE

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
CONSULTING ENGINEER, NEW YORK, N.Y.

IN a paper read before the Waterways Division on January 18, 1934, during the Annual Meeting of the Society, Mr. Hennebique gave the results of his study of and observations on the movement of bed materials along ocean shores in a direction generally parallel to them. In this article, prepared from that paper, he considers the sources of the material drifting along sandy shores, the forces causing littoral drift, and the effects on beaches of arresting the movement of this material. As an interesting example, he takes the drift in recent years of material westward along the south shore of Long Island, New York.

IT may be stated as a general principle that every foreshore has its own inclined surface of repose. If not impaired by incorrect structures, the profile of this surface is a uniform slope up to about mean sea level, and from there to the high-water line, a concave curve. The size of the beach material governs the angle of slope. A perfect type of foreshore is due to a balance of all the forces acting upon it. Its profile is then said to be in equilibrium.

When meteorologic conditions are normal, the breaking of the waves offshore is followed, first, by the uprush and then by the backwash without any visible motion of material other than the usual parabolic course of sand particles on the slope. This movement would mean a loss of material to the beach if there were not a corresponding replacement of littoral drift coming from neighboring shores.

PRINCIPAL TYPES OF CURRENTS

There are three principal types of currents which, singly or in combination, act as carriers for the transportation of littoral drift. Considered alone, as transporting agencies for debris, tidal currents are very seldom able to move anything coarser than silt. In general, the flood and ebb currents have small and nearly equal velocities along the open coast. These velocities increase appreciably at the entrances to tidal inlets.

When the incoming flood tide, traveling normal to the coast line, reaches the shore, it may separate into two parts, each of which follows the shore in an opposite direction, thus forming the nodal point of two opposite alongshore currents. However, if sufficiently urged by wind or wave, or both, it may bend entirely in one direction. In either case, the incoming tidal currents bring a volume of water to the shore line and therefore cause a rise in the water level.

It is often difficult to distinguish currents due to the wind from those caused by tides, when both are traveling in the same direction or approximately so. However, the cumulative effect of these forces is a greater velocity, which in turn means increased transporting power. A current due to an onshore wind may acquire much force, because it is assisted by the "fetch," or distance of open water over which the wind blows. On the other hand, a current generated by an offshore wind usually has little velocity.

The effect of wind blowing coastwise on a foreshore of moderate inclination may be noted visually, since the multiple ripples that appear will cause, as the result of the shallowness of the layer of water, an acceleration in the movement of beach debris. It is obvious that the value of this acceleration is a function of the slope and the magnitude of the wind.

Of the forces governing the motion and transportation of coastal material the most powerful are the wave currents. The oscillatory waves as they approach the shore have a slight rythmic pulsation, which increases in shallower water and becomes a slow current, too feeble in itself to move any material. But from this stage on to the plunge point, the velocity of this current increases progressively as the waves come in contact with the bottom and crowd closer together. It is clear that the transporting power of the current is a function of the wave's magnitude and that it helps to bring much material to the plunge point.

When the waves break they are entirely translatory in character and therefore exert horizontal energy proportionate to their mass and to the square of their velocity. The work performed by the ensuing rush of water, in eroding and transporting sand, will depend on the slope of backshore and foreshore and on the angle of wave approach. The effect of the hydraulic head created by single or cumulative action of the three currents just reviewed, is also a variable factor. However, it is of much importance in the formation of alongshore currents.

SOURCES OF DRIFT MATERIAL

The original source and composition of littoral drift depend on the geologic formation of the coast. Sometimes this material is composed of fragments derived from cliffs disintegrated by the combined action of rain and frost. Drift material may also result from the attrition or comminution of land caused by subaerial agencies.

Littoral drift is composed often of sand originally derived from the terminal moraines left by glaciers. Although a certain amount of sand, silt, and other alluvial matter comes down from the hills and valleys by way of the rivers, it does not follow that the source of all material now found on ocean shores is from these sources. In fact, a quantitatively important movement of drift material is always taking place in large offshore areas, and part of it is transported shoreward.

Another appreciable supply of drift is on the shore itself. Wherever there is erosion of a cliff or bank, or whatever the topography of the coast line may be, there will be a loss of coastal material above sea level, although there will be no loss of area.

ZONE OF DRIFT

The zone from which the drift material is derived may extend seaward from the water line to a place where the agitation of the waves is no longer felt on the ocean bed. The outside limits of this zone are determined by the severity and duration of storms. The flatter the ocean bed, the broader the zone, and vice versa.

When a wave passes into shallowing water, a to-and-fro movement is imparted to the debris on the bottom. Then the alongshore currents play their part and cause this movement to become serrated or dentated. As the agitation on the bottom becomes greater, the drift of the grains of sand increases accordingly, until they are finally transported either in suspension, by saltation, or by rolling, depending on the size of the debris and the magnitude of the forces moving them. Such movements of material are usually more pronounced during flood tides, since the grains of sand are then loose on the bottom, are "alive," and shift easily. The reason for this phenomenon is that during flood tide the water is not only flowing inshore where the water level is lower but also is trying to force its way upward through the sandy bottom because of the difference in hydraulic head.

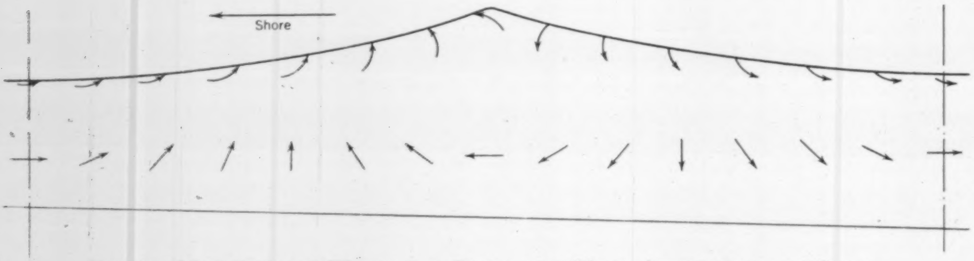


FIG. 1. MOVEMENT OF WATER AND DRIFT AS A WAVE APPROACHES THE SHORE

Littoral currents do not necessarily carry all the sand they are capable of transporting, and they never carry an overload. Neither do they always pick up a capacity load by scouring the beach, because where the bottom is hard and smooth—the ebb tides have a tendency to pack it—the currents may pass over it without causing erosion.

DRIFT FROM OFFSHORE

Debris moving on the ocean bed, either away from or toward the shore, is thoroughly sorted according to size. When the silt and mud are not carried away by littoral currents, or by flood tides or by both, to quiet resting places in coves or lagoons, they are gradually moved seaward, mostly during the ebb tide, and deposited in deep and wide areas where the agitation of the water is concentrated near the surface.

The size of the sand grain, rather than its specific gravity, determines the amount of travel produced by currents. It is evident that a grain of sand of small median diameter settles more slowly than a larger one and, therefore, is always carried farther before deposition, once it has been put in suspension. Variations in the temperature of the water also affect the rate of settlement. Thus the rate increases when the temperature rises, as a result of the decrease in viscosity and density. Conversely, the rate decreases when the water temperature falls.

In shallow waters abnormal waves scour up the sandy bed along the coast. If the sand is not too coarse, it is kept in suspension, is borne by the littoral currents, and is subsequently deposited over wide areas. Where the water is deeper, the effect is entirely different. The littoral currents pass over the irregularities of the ocean bed but, because of the depth, cause comparatively little disturbance. A smaller volume of sand moves in a thin film over the bottom and is arrested whenever the transporting current meets still water, or has its velocity reduced by other causes.

Waves that approach the beach at an angle break somewhat differently according to the slope of the shore. If there is equal wave magnitude the obliquity of the waves will be better maintained at the moment of breaking if the slope of the bottom is steep than if it is gentle. It may be inferred from this fact that the propulsion imparted at breaking will be more effective in a direction parallel to the coast in the case of a sharply inclined sea bed than in that of a gentle slope.

Debris brought up may spread on the foreshore until the profile becomes too steep and the pull of gravity equals the uprush. The tendency of the upper part of the foreshore to curve upward is due to the percolation of a part of the water into the beach, which reduces the volume of surface backwash water. Consequently, for lack of a transporting agency, the sand carried by the uprush is deposited at the turning point.

The importance of the movement of material in the zone just seaward of the plunge point is not usually realized. It may be stated that, even under normal weather conditions, as the plunge point moves landward with the flood tide, the plunge would scour a hollow corresponding in width to the path of the plunge point, if there were not a compensating supply of debris. This supply does not come from the foreshore, because the volume of material withdrawn would greatly lower its level, which it does not do. It may in part be derived from the alongshore drift, the amount depending on the velocity of the current. Therefore a fair proportion of the compensating load must be brought to the plunge point from the ocean bed.

This wave action and movement of material are shown schematically in Figs. 1 and 2. The upper arrows in Fig. 1 refer to the orbital motion of the water particles from center to center of the trough, as they move in the wave. The lower arrows show the direction of the motion of the mass of water and, in the forward half of the wave, the progressive tendency to lift the sand that precedes the forward movement. As the crest passes, the interaction of the upward and forward components is at a maximum, and ocean bed material is thereby entrained. After the crest passes and before the backward motion of the mass starts, the height of the water decreases and the settlement of bottom material is accelerated, thus impeding its retrocession. Therefore, upon the passing of one wave length at a given point, the resultant effect of the four components is an advance of material shoreward.

Although the values of A and B in Fig. 2 are variable, B is always greater than A. Both values increase proportionately as the wave nears the plunge point. The ocean bed slope and wave height are two participating factors. When the tidal current flows in the same direction as the waves, it will increase the values of A and B at flood tide, and decrease them at ebb tide.

FORMATION OF SAND BARS

A gently sloping shore, a flood tide, and waves breaking normal to the shore line, sweeping forward a full load of material, form a combination of factors favorable to the formation of a sand bar. It is conceivable that if all the water volume traveling shoreward were to return to its starting point as a bottom current, the amount of material carried by this current would be greater than that originating at the plunge point, which moves material shoreward. This is because the force of gravity helps one and retards the other.

On the other hand, if the gradient is gentle, the volume of water rushed forward is concentrated; its impulse is more potent; and it counteracts to a greater extent the opposite force of the undertow. This is the result of a succession of short, massed, translatory waves. Moreover, when currents are flowing on a comparatively flat gradient they carry more sand because the material is more agitated by the succession of breakers, is lifted higher from the ocean bed, and is more evenly distributed in the mass of the water in motion.

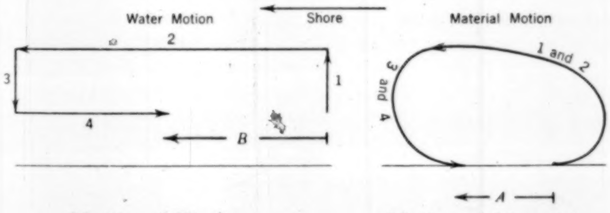
Thus, if the result of all conflicting forces on such a shore is the movement of material shoreward in a direction perpendicular to the water line, then a new shelf caused by the deposition of this greater load will spread over the bottom, since the debris in motion and the currents transporting it are always seeking equilibrium. The location of the initial point of this new shelf, or low ridge, is governed jointly by the velocity of the water, the amount of the load, and the size of the debris. The ridge may continue to grow and form a sand bar either with or without the assistance of alongshore currents adding their quota of material. When a littoral current is confined to a definite channel between the low-water line and an outlying sand ridge or bar, its strength may, at times, be greatly increased. If a shoal runs parallel to the beach, the velocity of the water in the gully or "low" so formed not only prevents deposition but may cause subaqueous scour.

EFFECTS OF ARRESTING DRIFT

If the profile of a foreshore is acted upon by favorable and mean tides, winds, currents, and littoral drift, it will be curvilinear and thus assume a definite angle of repose. However, the moment the balance of these forces is disturbed, there is an obvious change in the foreshore.

All obstructions perpendicular to the coast line will arrest the drift either partly or completely, according to their height and length. Harbor piers and riprap jetties or breakwaters extending offshore have the same effect as headlands and promontories; they completely arrest the drift. Although they may cause impounding of the sand on one side, they invariably cause serious erosion on the other side and starve the neighboring shore.

The accompanying photograph shows the rock breakwater at Rockaway Point, on the south shore of Long Island, which was begun in 1931 and completed in 1933. Built to stabilize the channel leading to Jamaica Bay, it completely arrests the abundant drift traveling westward, and thus prevents the formation of shoals in the channel. Since 1835, when the first reliable survey was made, the Rockaway sand spit has moved westward at a fairly uniform rate of 240 ft per year. At the time of the survey its westerly end was over one mile east of Barren Island, but its point is now about three miles west of the island. Even before the breakwater was completed, large quantities of drifting sand accumulated on the east side of it.

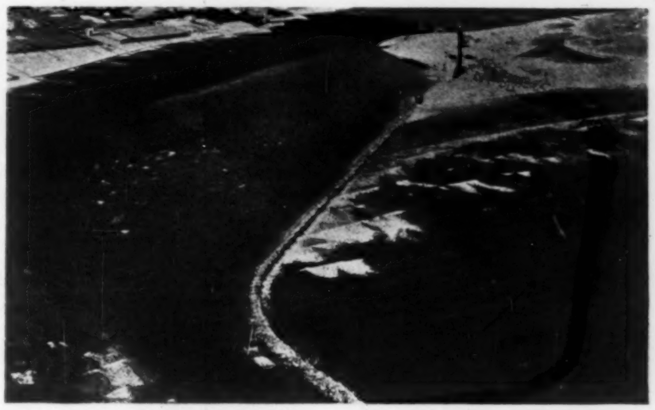


Motion of Water

Motion of Material

Fig. 2. Motion and Resulting Translation of Particles of Water and Material

Further evidence of the predominant westerly drift along the south shore of Long Island is shown by the westerly migration of East Rockaway, Jones, Fire Island, and Moriches Bay inlets. The potentialities of Jamaica Bay as a harbor probably justify this particular breakwater. However, the erection of this type of structure on any section of open coast would damage the adjacent beach by depriving it of its rightful share of the littoral drift.



© *Aerial Explorations Inc.*

Breakwater at Rockaway Point, L.I., Protects the Channel Leading to Jamaica Bay
Completed in August 1933

Care must be taken to avoid confusion between such obstructions and the low structures called groins. When properly designed as to height, length, slope, and spacing, groins are recommended because, while they accumulate a sufficient amount of drift material to build up the shore gradually, they allow the rest of it to pass for the benefit of nearby beaches.

Littoral drift is necessary for the preservation of beaches. If the supply of drifting sand were cut off for a certain period on a given section of open shore, the foreshore would be progressively denuded of its sand to the point where the clay and old marsh base, or whatever composed the subjacent strata, would be exposed. In 1926, for example, denudation of the foreshore of Cape May Beach, N.J., was accelerated by the rows of rocks at the high-water line. In 1916 another example of similar conditions, on a much larger scale, occurred in British Guiana, South America. Several sections of the 52 miles of shore, for which I later designed shore-protection structures, were denuded. One stretch, that at Clonbrook, on the east coast, had no drift whatsoever because it was intercepted by the discharge of Mahaica Creek.

Littoral drift is the most important factor involved in problems of coast erosion and shore protection. Its proper distribution and repartition is essential. Therefore any shore structure that completely arrests the drift, thereby starving the neighboring shore, should not be permitted. This conclusion is offered in the belief that it will be helpful in the preservation of sandy beaches everywhere.

It is a pleasure to acknowledge the initial counsel and advice I received twenty years ago from the noted coastal engineer, G. O. Case, of London.

World Progress in Water Supply Engineering

Brief Review of the Report of the Committee on Water Supply Engineering to the Sanitary Engineering Division on January 18, 1934, at the Society's Annual Meeting

As its major activity, the Committee on Water Supply Engineering has developed a review in brief of world progress in the field of water supply. It has not limited itself to its own knowledge but has enlisted the aid of other well-informed engineers. The report from which this review has been abstracted is signed by the members of the committee: Thomas H. Wiggin, Chairman; and F. A. Barbour, L. R. Howson, C. G. Hyde, and F. H. Stephenson, all members of the Society.

CEMENT

In recent years the significant development has been a trend away from the so-called "standard specifications" for portland cement. The advanced engineer is now specifying cement to meet the particular needs of his product. Highways want quick-setting cement, whereas slow-setting and low-heat cement are required for massive masonry structures. The quick-hardening variety depends mainly on an increase in the lime content, which is thought to cause an increase in the more active constituent, tri-calcium-silicate. The slow-setting, low-heat cements are made with less lime, less alumina, more ferric oxide, and more silica.

DAM CONSTRUCTION

Methods unusual in masonry dams were used in the Pine Canyon Dam. About 500,000 bbl of low-heat cement were used, actual tests of which indicated the development of not more than 65 calories of heat per gram in 28 days. The concrete in the body of the dam had a cement-water ratio of 1.68 and a slump of only 1 in. or less. Internal and external vibrators were used, but the internal type gave the most satisfactory concrete.

At Boulder Dam the purpose of cooling the concrete is to complete its shrinkage before the dam is made into a structural unit by grouting of the joints. Excess heat is being removed in a short period by the circulation of cold water through steel pipes 1 in. in diameter and spaced about 5 ft 9 in. apart throughout the mass.

No new principles have been applied recently in the construction of earth dams, but there is doubtless a more general understanding of the selection of material by determining its perviousness and moisture content; also its grain size in hydraulic fill dams, as illustrated by the Cobble Mountain Dam of the Springfield, Mass., water supply. In compacting rolled dams, the sheep's foot roller and solid-tired trucks have been used increasingly, particularly in the West.

PIPE AND PIPE COATINGS

In the field of fabricated steel plate pipe, the general acceptance of automatic fusion welding for shop fabrication has made possible smooth steel plate pipe, the field joints being made either by fusion welding or by couplings of the Dresser type, or by both in the same line.

As regards cast-iron pipe, the trend is definitely toward centrifugal casting, at least two important foundries having closed their pit cast shops. Steel pipe made with plates wound spirally, and with joints both interlocked and electrically welded, has shown good qualities when subjected to bursting tests in the laboratory and has come on the market.

Transite pipe, made of asbestos fiber and portland cement consolidated under heavy pressure, is a newcomer in the American market, although extensively used for some years in Italy. Its use is indicated where resistance to tuberculation by water, to soil corrosion, and to electrolysis, and in industrial plants to corrosive gases, is desired. Cement mortar linings for cast-iron pipe have become widely accepted, and cement mortar linings and coatings for large steel pipe are coming into use. Machine-applied cement wrapping has been employed as an outside protection on two important lines. Centrifugally applied hard bitumastic enamel, which has been used for several years in cast-iron pipe, has been applied to recent steel pipe jobs. There have developed during the last year small centrifugal machines with which the pipe purchaser can apply bitumastic enamel to tar-dipped pipes in his own yard before laying.

There has been under development during the past year or more a method of testing for pin holes and holidays in heavy bituminous coatings by means of a high potential electric spark. It appears to be capable of discovering every pinhole, large air bubble, or other important mechanical defect in the coating.

REMOVAL OF TASTE AND ODOR FROM WATER

Activated carbon will remove any objectionable taste or odor likely to be present in a water supply. It is effective when all other methods fail. There is a great difference in adsorptive capacity of various carbons and a very active carbon is more than 100 times as effective as ordinary charcoal.

Improvements continue in the methods of applying chlorine, both with and without ammonia, and in determining the amounts which are required. It may almost be said that a new technic has been developed for the determination of chlorine residuals.

IMPROVED PUMPS AND PRIME MOVERS

As is well known to water supply engineers, the centrifugal pump has replaced to a large extent all other forms of pump. Whereas twenty years ago efficiencies of 80 per cent were high, today efficiencies up to $91^1/_2$ per cent are obtainable in the larger sizes. The electric motor as a prime mover is being increasingly used on account of its convenience, little attendance required, high efficiency, and the greater availability of electric power. Tests of synchronous motors recently installed in New Jersey, having 350 to 650 hp, averaged 96.5 per cent at full load. There is an increased use of the Diesel engine in horsepowers below 400.

The high-speed steam turbine is the outstanding development in steam pumping station practice during the past few years. Turbines with high thermal efficiency and low first cost are now available in capacities as low as from 200 to 300 hp.

NEW UTILITIES ACCOUNTING METHODS

The depression has accelerated the re-study of methods of utility accounting, valuation, going-concern value, depreciation, and rate-making. There is a tendency to change methods which have been more or less generally used in recent years.

OUR READERS SAY—

In Comment on Papers, Society Affairs, and Related Professional Interests

More Education Required

To the Editor: In the symposium on taxation, in the August issue, Mr. Bane gave an able presentation of the reasons why a reduction in state taxes is impracticable. He showed that, although any reduction in the services now rendered by the state might result in a smaller tax bill, it would increase the costs to the taxpayers in other directions, far in excess of the small savings accomplished.

The same facts can be demonstrated for other subdivisions of government, which now render desirable and necessary public services far more cheaply than they can be rendered by other agencies. Demands for reductions in the cost of any governmental service always have a popular appeal, but the public usually expects such cost reductions to be made without reducing the services rendered. Mr. Bane rightly contends that educational costs can be reduced, "if the citizens are willing to sacrifice the quality and quantity of the education afforded their children." No thinking or informed person believes that Americans will be willing either to make such a sacrifice or to permit selfish interests to force that sacrifice upon them—for the profit of these selfish interests.

Those familiar with school costs in some of the larger cities believe that these costs can be reduced, without a reduction in the services rendered, by eliminating the graft in the business administrations which deal with such items as construction of buildings, purchase of land, supplies, and insurance. Most advocates of reduced school costs neglect to mention these items, either purposely or through ignorance of their subject, but confine their attacks on the schools to demands for larger classes, fewer teachers, and lower salaries for the teachers retained.

In order to save taxes for large property holders, it is sometimes suggested that high school and university education should be made available only to the children of families able to pay the entire cost of this education, now borne by states and school districts. Rather, our present conception of free public education will be improved to give the next generation a truer appreciation of the value to the Nation of a free, public educational system, so that in the future there will be fewer who wish to deprive succeeding generations of the educational advantages that they themselves enjoyed.

So long as we as a nation can afford to spend over twice as much annually for candy, chewing gum, and theaters as we do for education, we cannot afford to reduce in any degree the educational advantages extended to our children. In fact, if we fail to increase our expenditures for education, we will pay dearly for it in the future. The alarming increase in the number of children now denied an education because of the ruthless closing of public schools is a warning and a challenge to every patriotic citizen who gives a thought to the future welfare of the country. Chicago's treatment of its teachers for the past two years must bring a blush of shame to every self-respecting citizen of the city. Any one not familiar with that story should read it in the December 1933 issue of the *Atlantic Monthly*.

Engineers sometimes resent—and rightly so—laymen trying to pass judgment on complex engineering problems about which they know little or nothing. We should be consistent when dealing with other professional men who have made a life study of the needs of our educational system. Perhaps they know more than we do about their own specialty. They know that it is no more sensible to suggest to educators that we should go backward fifty years and teach only "the three R's" than it would be for educators to suggest that we go back to horse and buggy transportation and to hand labor in industry in order to balance our budgets.

W. C. Hogoboom, Assoc. M. Am. Soc. C.E.
Structural Engineer, Division of Bridges and Structures, City of Los Angeles

Los Angeles, Calif.
January 28, 1934

Comments on José Maria Villa

To the Editor: In your January issue I read with much interest the article by F. R. Molther, entitled "A Pioneer Suspension Bridge in Colombia." In it he has mentioned my name and has made me appear a casual visitor to the bridge while it was under construction. For this reason, and also because I knew José Maria Villa quite intimately and was aware of his eccentricities, I feel that readers of Civil Engineering may be interested in what I have to say.

To begin with, I was commissioned by the Governor of the Department of Antioquia to make a report on the Puente del Occidente and to give my opinion as to whether it would be advisable for Dr. Villa to continue the construction of the bridge or whether the department should stop spending money on it. At the time a landslide threatened the west anchorage of the bridge.

On arriving at the place I found everything closed and a solitary caretaker in charge of the shop. I showed him my credentials and asked him to submit all the maps and estimates that I needed for my report. Imagine my dismay when he pointed to a charcoal sketch on a whitewashed wall and said, "That is the only map I ever saw here." I then had to measure the temporary bridge already up, including the towers, in order to come to some conclusion. In the storeroom I found the suspension plates, the saddles, and wires, and from their measurements I constructed graphically the suspension bridge. On my return to Medellin I reported to the Governor and advised the continuation of the work, which I considered very important.

In 1893 I left Colombia. While looking over some old papers, I came across a notebook containing some data about the Puente del Occidente; whereupon I wrote an article for the *Engineering News*. A translation of this reached Dr. Villa, who was unreasonably angry because, thinking to praise him, I called his bridge "a daring piece of engineering and a courageous departure from established principles and practice." Mr. Molther's article proves that I was right. The wonder to me is that, considering the incomplete information I had to go on, I came so close to Dr. Villa's estimates. Any engineer will appreciate that.

Although Dr. Villa's eccentricities have been exaggerated by Mr. Molther, they were real. He was a genius and, as such, was privileged and excused for many of his faults, including that of drinking *aguardiente*. He was loved and admired by every one who knew him, myself included, and although he treated me rather roughly, I knew how to take it.

Francisco Escobar

Brooklyn, N.Y.
February 3, 1934

Slum-Clearance Projects Need Federal Subsidy

To the Editor: The article by Mr. Millar on "Preparedness for Slum Clearance," in the September 1933 issue, is very timely. As an integral part of its recovery program, the present administration is preparing to use Federal funds in the rather sadly neglected field of slum clearance. Since this tremendous influence will soon make itself felt in real estate circles in our larger cities, consideration should be given to some of the more important phases of the problem.

First, an attempt should be made to ascertain the origin of these blighted districts. All authorities concede that decentralization, that is, the outward movement of population, is the prime cause. Most slum districts were originally residential sections of single and multiple family dwellings, which developed until the majority of the lots were occupied by buildings. Records indicate that, during such periods of development, there is always an increase in property values. With the passage of time, however, the district becomes too densely populated, and multiple occupancy of the same quarters increases apace. Ultimately there is no higher use for these land sites, which leads to a lack of bids from buyers and lessees, and a subsequent decline in their quality and value.

In carrying this picture to its logical conclusion, we find that the better class resident of this district, who is endowed with the necessary financial means, will move to some other part of the city or to a suburb where crowded conditions will not obtain. As a result of this decentralization movement, only the poorer class remains, and from this period on the forces tending to produce slums move very rapidly.

It is obvious then that the blame for slums cannot be placed definitely on the shoulders of either city officials, landlords, or tenants, although all three have been held responsible by various critics. However, all concede that the evil exists and that it must be eliminated, although there is much doubt in my mind as to whether the Government's intervention will aid materially.

From our experience in the Lower East Side districts of New York City, we have found that the typical slum dweller can afford to pay a maximum rent of about $3 or $4 per room, the average apartment consisting of three or four rooms. This type of multiple dwelling house is abundant in a large area of the city, with many apartments renting as low as $2 per room per month. However, even with the so-called "low-cost housing" plans being fostered by private initiative backed by Government financing, it will be economically impossible to rent new apartments in the neighborhood of the previously mentioned maximum figure. While it is true that many ancient and decrepit dwellings will be razed in order to make way for these new housing projects, only a small percentage of the occupants will be able to take advantage of the new facilities provided. The rest will be obliged to seek quarters in other low-priced slums or else will encroach on neighboring residential districts, thus hastening the deterioration of these adjoining properties and creating new and equally blighted slum areas.

This represents a rather gloomy view of the new slum-clearance program, but until such time as governmental authorities, either city, state, or Federal, recognize the real issues involved in the problem and agree to subsidize that part of the expense necessary to provide low-cost housing on which a return or an amortization is economically impossible, the slum evil will remain with us.

JOHN T. REYNOLDS, Jun. Am. Soc. C.E.
Manager, Northeastern Real Estate Securities Corporation

New York, N.Y.
February 3, 1934

Effect of Overgrazing in Utah

TO THE EDITOR: The article on "Erosion and Watershed Protection," by Mr. Hoyt, in the February issue, is very interesting. For the past year unusual interest has been taken in the matter of floods throughout the intermountain country, opinions being divided as to whether or not overgrazing was largely responsible.

For a number of years I resided in Utah—from 1885 to 1904 and again from 1910 to 1917. My work necessitated frequent trips to various parts of the Book Cliffs coal field and the Wasatch Plateau. Since 1917, I have been identified with the Utah Highway Department, which has increased my familiarity with this section of the state.

Intense local thunderstorms on the Wasatch Plateau have always produced floods. The quick run-off and rapid erosion, however, did not occur from above the cretaceous formation until within recent years. Any heavy thunderstorm caused floods on the tributaries of the Colorado, heading in the Wasatch Plateau, below an elevation of approximately 7,000 ft where the range was bare and very precipitous. Above this elevation and on the entire western slope of the Wasatch Plateau (Salina Canyon excepted, where conditions were similar to the eastern escarpment) there was absolutely no quick run-off, and on the western side no floods, from the days of the pioneers until about 1888. For some years I was superintendent and chief engineer of a little 55-mile railway, with headquarters at Manti, Utah, when that region was experiencing so much trouble from floods.

While loath to acknowledge it, the citizens interested in the livestock industry finally became convinced that the other property owners were correct. Beyond doubt overgrazing caused the floods. When the livestock men were won over, the citizens succeeded in having livestock excluded from that part of the Wasatch Plateau east of Manti to the summit. Later a very limited number of cattle were allowed on the reserve.

Within a few years after the practical exclusion of livestock from the area east of Manti conditions righted themselves. The area back of a dam constructed in the canyon to hold back debris was filled in a few years. By that time and since there has been no excessive run-off from the drainage area of Manti Creek, though there have been frequent minor floods in adjoining canyons.

There is not the slightest doubt in my mind that overgrazing caused these floods, resulting in serious damage to property west of the Wasatch Plateau, and increased the run-off on the eastern side, where however floods have always been prevalent below about the 7,000-ft contour.

During the past few years our highway department has had considerable expense from summer flood damage due to overgrazing. One particularly bad section is immediately north of Salt Lake City, on U.S. 91, a much used highway. Prior to four years ago we had no trouble; now it is an annual experience. To preserve continuity of travel we have constructed a parallel highway further to the west. City Creek Canyon, a restricted area, parallels this highway a few miles to the east. None of the summer storms that have caused so much trouble north of Salt Lake have affected this restricted area to the slightest extent.

Three years ago summer storms resulted in an additional maintenance expense to the highway department of over $150,000. Practically all this expense was due to floods from overgrazed lands in private ownership or quick run-off on desert sections, particularly the desert in eastern Utah within the Colorado drainage area.

With us, overgrazing is not a theory but a very expensive fact, and we are heartily in favor of enlarged Forest Service supervision, which to my personal knowledge has been so satisfactory.

H. S. KERR, M. Am. Soc. C.E.
Chief Engineer, Utah State Road Commission

Salt Lake City, Utah
February 3, 1934

Flow of Water Under Dams

DEAR SIR: There is much of interest in the article by Mr. Hill, in the January issue, in which he describes experiments on the flow of water under dams on permeable foundations.

Many years ago, in collaboration with the late E. E. Sands, Assoc. M. Am. Soc. C.E., I undertook experiments for a similar purpose, but unfortunately, owing to lack of suitable apparatus, we did not carry them to a conclusion. Our working hypothesis was that the flow of electric current in a thin plate of some highly resistant material should be similar in character to the flow of water through a highly resistant medium, such as compacted sand or gravel. The difficulty was to find a suitable material. After many trials we finally decided on a thin layer of fine sand mixed with ground arc carbons and moistened with saline water. The layer was about $^1/_8$ in. thick. The only available source of current was dry ignition cells (somewhat old), and the measuring apparatus was a small voltmeter of doubtful origin and uncertain accuracy.

The result of the experiment was a picture not unlike Mr. Hill's Fig. 1, except that we drew the equipotential lines and sketched in the lines of flow. Although we planned to repeat the experiment and use blotting paper moistened with water, we never did. It appeared that the material should not be too resistant, that a fairly large potential difference should be used, and that the voltmeter should have a very high resistance.

H. B. MUCKLESTON, M. Am. Soc. C.E.
Consulting Engineer

Vancouver, B.C.
January 22, 1934

SOCIETY AFFAIRS

Official and Semi-Official

Code of Fair Competition for the Construction Industry

Approved by President Roosevelt on January 31, 1934

Chapter I of the Construction Code, here reproduced in its complete form, goes into effect on March 2, 1934. This first chapter constitutes the master code, which must be observed in conjunction with the chapters that are to be added from time to time for the specific divisions of the industry. Thus the members of a particular division will be governed jointly by Chapter I and their specific divisional chapter, the two being inseparable. More than a score of divisional chapters have been submitted to the NRA, among them the professional engineers' code, and are being considered.

A feature of Chapter I is provision for the establishment of a National Construction Planning and Adjustment Board consisting of ten representatives of employers and ten representatives of employees presided over by an impartial chairman, who will be the representative of the Government. To it, by consent of all interested parties, differences relating to wages, hours of labor, and working conditions are to be submitted. The President has already suggested, as one of the first duties of the board, the making of a complete study of trade jurisdictional disputes, their causes, origin, and amicable solution.

In this copy of the Construction Code a few section headings have been added to the official version for purposes of identification. Additional copies of Chapter I may be obtained at 5 cents each from the Construction League of the United States, 1741 New York Avenue, Washington, D.C., or from the Superintendent of Documents, Government Printing Office, Washington, D.C.

To effectuate the policies of Title I of the National Industrial Recovery Act, the following provisions are established as a Code of Fair Competition for the Construction Industry, and shall be the standard of fair competition for this industry and shall be binding upon every member thereof.

Chapter I—General Provisions

ARTICLE I. APPLICATION

The provisions of this Code shall apply to the entire industry as hereinafter defined, excluding operations therein undertaken in accordance with bona fide bids made not more than sixty (60) days prior to the effective date, or contracts entered into prior to the effective date; except that the provisions of each chapter incorporated in this Code shall apply only to the division or subdivision of the industry defined in such chapter. In the case of conflict between such chapter provisions and the general provisions of this Code, the chapter provisions shall govern. If any other code of fair competition or a provision thereof, heretofore or hereafter approved by the President, shall conflict with this Code or with any provisions thereof, the Administrator may hold such hearings as he may deem necessary and thereafter may, if in his judgment justice requires, grant such stay, exception or exemption, or make such other determination as he may deem advisable to effectuate the policies of the Act.

ARTICLE II. DEFINITIONS

Section 1. Construction Industry

The term "construction industry" or "the industry" as used herein shall include the designing and the constructing of (and the installing and the applying, including the assembling at the site, of manufactured parts and products incorporated in and to):

(*a*) building structures, including modifications thereof and fixed construction accessory thereto, intended for use as shelter; and other

(*b*) fixed structures and other fixed improvements and modifications thereof, intended for use in industry, commerce, sanitation, transportation, communication, flood control, power development, reclamation and other similar projects or services; and such related divisions or subdivisions thereof as may be defined in chapters hereof, and included hereunder with the approval of the President.

Section 2. Divisions of the Industry

The term "division of the industry" or "division" as used herein shall mean a branch of the industry which has been or may hereafter be defined in a particular chapter of this Code. The term "subdivision of the industry" or "subdivision" shall mean a defined section of a division.

Section 3. Member of the Industry

The term "member of the industry" as used herein includes any individual or form of organization or enterprise engaged in any phase, or undertaking to perform any of the functions of the industry as defined in Section 1 hereof either as an employer or on his own behalf, including also but without limitation, architects, engineers, contractors and subcontractors.

Section 4. Member of the Division

The term "member of the division" or "member of the subdivision" includes any member of the industry engaged in one of the divisions or subdivisions of the industry now or hereafter established.

Section 5. Employee

The term "employee" as used herein shall include any person engaged in any phase of the industry, however compensated, but excluding members of the industry.

Section 6. Employer

The term "employer" as used herein includes anyone by whom any such employee is compensated or employed.

Section 7. President, Act, Administrator

The terms "President," "Act," and "Administrator" as used herein shall mean, respectively, the President of the United States, the National Industrial Recovery Act, and the Administrator of Title I of said Act.

Section 8. Effective Date

The term "effective date" as used herein shall mean the thirtieth (30th) day after the approval of this Code by the President, provided that in respect of a particular division an earlier effective date may be specified in the chapter applicable to such division.

Section 9. Sponsors

The term "sponsors of the Code" as used herein means the following national associations of members of the industry which have applied for the approval of this Code and signified their assent thereto:

1. Construction League of the United States
2. American Institute of Architects
3. American Society of Civil Engineers
4. Associated General Contractors of America
5. International Society of Master Painters and Decorators, Inc.
6. Heating, Piping and Air Conditioning Contractors National Association
7. Cement-Gun Contractors Association
8. National Building Granite Quarries Association
9. Contracting Plasterers International Association
10. Tile and Mantel Contractors Association of America
11. National Association of Master Plumbers of the United States
12. National Elevator Manufacturing Industry
13. Roofing and Sheet Metal Industries Conference
14. Mason Contractors Association of United States and Canada
15. American Road Builders Association
16. National Association of Metal Furring and Lathing Contractors
17. Asbestos Contractors National Association
18. National Association of Building Trades Employers
19. National Association of Builders Exchanges
20. American Construction Council

and such other national associations of members of the industry as shall in like fashion hereafter sponsor additional chapters of this Code.

Section 10. This Code

The term "this Code" as used herein shall mean and include, unless the context clearly indicates otherwise, all chapters from time to time included herein, together with any modifications or amendments thereto.

Section 11. Population

Population, for purposes of this Code, shall be determined by reference to the 1930 Federal Census.

ARTICLE III. HOURS, WAGES, AND CONDITIONS OF EMPLOYMENT

Section 1. Mutual Agreements

In each division or subdivision of the industry, as defined in the chapter incorporated in this Code relating thereto, truly representative associations or groups of employers and employees respectively concerned, after proper notice and hearing and as a result of bona fide collective bargaining, may establish by mutual agreement (when approved by the President as provided in Section 7 (*b*) of the Act), for a specifically defined region or locality the standards of hours of labor, rates of pay and such other conditions of employment, relating to occupations or types of operations in such division or subdivision, as may be necessary to effectuate the policy of Title I of the Act. For the purposes of this Section, the entire United States may be defined as a region. The terms of such an agreement between the employers and employees of a division or subdivision of the industry shall not be binding upon the employers and employees of any other division or subdivision of the industry.

After the President has approved any such agreement arrived at within any such division or subdivision, and after proper notice of such approval, it shall be deemed prima facie unfair competition for any employer in such division or subdivision to fail to comply with the standards of maximum hours of labor, minimum rates of pay or other conditions of employment so approved and prescribed by the President, in respect of the performance within the defined region or locality of the types of operations concerned; and the failure of such an employer to desist from such unfair competition after being given due notice and opportunity to be heard, shall constitute a violation of the requirements of this Code.

The Administrator shall establish one or more Boards for each division or subdivision of the industry concerned to investigate any complaints of unfair competition as defined in this Section. Each such Board shall consist of two representatives each of employers and employees of the division or subdivision affected, selected by the Administrator from nominations made by such employers and employees respectively in such manner as the Administrator may approve or prescribe, and an impartial chairman named by the Administrator from nominations made by the employer and employee representatives selected to the Board. Each Board shall give notice and opportunity to be heard to each complainant and respondent and thereafter notify said parties of its findings and report them to the Administrator, as a basis for appropriate action to enforce the requirements of this Code. The provisions of this Section shall not be construed to limit the power of the President, in the absence of such a mutual agreement, to exercise any authority conferred upon him under Section 7 (*c*) of the Act.

Section 2. Other Hours and Wages

Where no applicable mutual agreement, as provided in Section 1 of this Article, shall have been approved, employers shall comply with the following provisions as to minimum rates of pay, and maximum hours of labor:

A. No employee, excluding accounting, office and clerical employees, shall be paid at less than the rate of forty (40) cents per hour, provided, however, that the provisions of this paragraph *A* shall not be construed as establishing a minimum rate of pay for other than common or unskilled labor; and provided further that such provisions shall not be construed to authorize reductions in existing rates of pay.

No accounting, office or clerical employees shall be paid at less than the rate of $15.00 per week in any city of over 500,000 population or in the immediate trade area of such city; $14.50 per week in any city of between 250,000 and 500,000 population or in the immediate trade area of such city; $14.00 per week in any city of between 2,500 and 250,000 population or in the immediate trade area of such city; and $12.00 per week in towns of less than 2,500 population.

The foregoing provisions of this paragraph *A* establish a minimum rate of pay which shall apply, irrespective of whether an employee is actually compensated on a time-rate, piece-work, or other basis.

B. No employee shall be permitted to work in excess of forty (40) hours per week or in excess of eight (8) hours in any twenty-four (24) hour period, with the following exceptions and limitations:

1. On application of the interested parties and after approval of the National Construction Planning and Adjustment Board or Regional Boards established by it, an employee may be permitted to work forty-eight (48) hours in any one week when the following conditions obtain:

   (*a*) On projects located at points so remote and inaccessible that camps or floating plants are necessary for the housing or boarding of a majority of the labor employed.

   (*b*) On such remote projects, when working time has been lost because of inclement weather or unavoidable delays in any one week, it may be made up in the following four weeks.

   (*c*) On projects in localities where a sufficient amount of qualified labor is not available in the immediate vicinity of the work.

2. The foregoing maximum hours of work shall not be construed as a minimum, either for a day or for a week, and if at any time in any locality truly representative groups of employees in a division or subdivision of the industry, through their chosen representatives, express by written request to their employer or employers a desire to share available work in such division or subdivision, the number of hours of work may be reduced by mutual agreement between such employees and their employer or employers. In the event of inability to arrive at an agreement which will not involve undue hardship on either employees or employers, then such difference, with the consent of all parties in interest, may be submitted to the National Construction Planning and Adjustment Board for a decision. The National Board may require the Regional Boards to secure facts and full information relative to such dispute and submit the same to the National Board for its information.

It is not, however, the intent of this provision that any such reduction will be recommended by the National Board to be put into effect if it appears probable that undue hardship might be occasioned thereby to either employers or employees.

3. The following classes of employees are exempt:

(*a*) Employees engaged in professional, executive or supervisory work.

(*b*) Employees in establishments employing not more than two (2) persons in towns of less than 2,500 population, which towns are not part of a larger trade area.

(*c*) Employees engaged in emergency work, involving breakdowns or protection of life or property.

(*d*) Watchmen.

(*e*) Other employees who may be exempted in chapters of this Code specifically applicable only to the divisions or subdivisions of the industry therein defined.

4. Accounting, clerical or office employees may be permitted to work not in excess of forty (40) hours per week averaged over a period of four consecutive weeks.

C. No employer shall knowingly permit any employee to work for a total number of hours in excess of the hours herein prescribed, whether employed by one or more employers.

Section 3. Exemptions

Where provisions concerning hours of labor or rates of pay have been established for specific projects, by competent governmental authority or agencies (whether Federal, state or political subdivisions thereof) acting in accordance with law, any employer required to comply and complying with the provisions so established shall be relieved of compliance with any conflicting provisions of this Article or of any actions taken in accordance therewith.

Any employer required to comply and complying with the provisions of a valid labor agreement in force on the effective date shall be relieved to the extent of his legal obligations thereunder of compliance during the period of such agreement, with any conflicting provisions of this Article, or of any actions taken in accordance therewith.

Section 4. Minimum Age

No employer shall employ any person under the age of sixteen (16) years, or under the age of eighteen (18) years in any occupation hazardous in nature or dangerous to health.

Section 5. Construction Planning and Adjustment Boards

There shall be established within thirty (30) days from the effective date of this Code, a National Construction Planning and Adjustment Board, and said Board shall consist of twenty-one (21) persons, ten of whom shall be selected by the Industrial Advisory Board of the National Recovery Administration from nominations of the Construction Code Authority and ten shall be selected by the Labor Advisory Board of the National Recovery Administration from nominations of the construction employee organizations, the selection in each case to be subject to the approval of the Administrator, and one person to act as disinterested chairman to be selected by the President upon the recommendation of the Administrator.

The National Construction Planning and Adjustment Board shall have for its fundamental purpose the planning and the development of policies that embrace the broad spirit of cooperation and good will in the furtherance of all matters that relate to the promotion of better relations between employers and employees within the industry and the furtherance of other matters of their mutual interest. It shall have the authority upon its own motion to select technical advisors and seek the cooperation of all factors involved in the stabilization and promotion of the well-being of both employers and employees in the industry, and shall have authority to make such rules and regulations for its own conduct as it may deem necessary.

It shall, in its own discretion, following the submission by consent of all parties in interest of any difference within or between any divisions or subdivisions of the industry, give consideration and make determinations on all such differences as may arise relating to wages, hours of employment, and working conditions. The decisions of the National Construction Planning and Adjustment Board shall be final and binding on all parties in interest, except that in the event the representative of the Government, the disinterested Chairman, shall dissent from the conclusion, the decision shall be held in abeyance until approval or disapproval has been given by the Administrator.

The National Construction Planning and Adjustment Board shall have the authority, and upon its own motion shall establish in properly defined areas, Regional Construction Planning and Adjustment Boards, and said Boards shall be composed of an equal number of members from employer groups and employee groups, and it is further provided that there shall be no disinterested or impartial chairman of said Regional Boards, it being provided that such Boards shall select from their members a chairman and a secretary. The National Construction Planning and Adjustment Board shall upon its own motion submit to the Regional Boards, such problems for study as may in the opinion of the National Board be necessary and such reports of the Regional Boards shall be submitted to the final examination of the National Board.

To these Regional Construction Planning and Adjustment Boards may be submitted matters from their respective areas in disputes having the same relationship as matters to be submitted to the National Board, and every effort on their part shall be made to reconcile such existing differences with the requirement that their action shall in all instances be submitted to the National Board for final action.

Nothing in this Section shall be construed as preventing employers and employees in any division or subdivision of the industry as defined in the chapter incorporated in this Code relating thereto from submitting to the Boards provided for in Article III, Section 1 or other Boards similarly composed and selected for consideration and determination, differences that may arise relating to wages, hours of employment, and working conditions, subject to the approval of the Administrator. The findings of fact and determination of such Boards shall be submitted to the National Board for its information.

The cost of conducting the National and Regional Boards herein provided for, shall be borne by the Construction Code Authority, subject to a budget submitted to and approved by it, provided, however, that the cost of the services and the expenses of the members of said Boards, shall not be paid by such Authority.

ARTICLE IV. ADMINISTRATION

To further effectuate the policies of the Act and to administer this Code within the industry and its divisions and subdivisions, there shall be established a Construction Code Authority, and Divisional Code Authorities, and other administrative agencies as hereinafter provided:

A. Construction Code Authority

Section 1. Constituency

The Construction Code Authority shall consist of one member selected from and appointed by each of the sponsors of this Code, enumerated in Article II, Section 9 hereof as sponsoring this Code as originally submitted to the President for his approval; except that the Associated General Contractors of America may appoint thereto not more than four (4) members, one of such members to be selected respectively from each of the following component membership groups of said organization: Building Construction, Highway Construction, Railroad Construction, Public Works and other types of construction not heretofore specifically enumerated; together with not more than three non-voting members to be appointed by the Administrator to act as his representatives. To the Construction Code Authority as so constituted and established there may be designated not more than one additional member in respect of each additional chapter hereafter incorporated herein, provided that no such additional member shall be selected by any association enumerated in Article II, Section 9 hereof. The method for the selection of each such additional member shall be described in the corresponding additional chapter. The term of such appointments shall not exceed two years, except that, in the event of code continuance beyond the limit now established by law, terms may be readjusted to insure overlapping tenures of office pursuant to a plan or method approved by the Administrator. Voting members are subject to replacement by the selecting agency with the approval of the Administrator.

Section 2. Powers and Duties

The Construction Code Authority, acting as a unit or through any designated committee or department created by it from its membership, shall have, in addition to any other powers or duties herein conferred upon it, the following powers and duties:

(*a*) It may establish rules and regulations for the conduct of its affairs; and may appoint such committees, agencies and representatives, and delegate to them such of its powers and duties as it may deem necessary for the proper discharge of its functions hereunder.

(*b*) It shall be empowered to cooperate with the Administrator in making investigations and surveys concerning the functioning of this Code, the observance of its provisions and other pertinent matters whether at the request of the Administrator or otherwise, and report its findings and recommendations to the Administrator.

(*c*) It shall collect from members of the industry and compile and furnish to the Administrator any reports and other information required under the Act. Except as may be required for the effective enforcement of the provisions of this Code the reports of individual members of the industry required under this Code shall be confidential and only compiled summaries of such individual reports shall be furnished.

(*d*) In order to collect the information for the Administrator herein called for, it may require, either directly or through any Divisional Code Authority, the registration, in such manner as it may deem appropriate, of all construction work or services of or in excess of $2,000. in value, and in order to defray the expenses of such registration and of the administration of this Code may apportion such expenses on the basis of the value of the work or services so registered, but in no case shall the charge be less than $2.00. The proceeds derived therefrom shall be apportioned upon an equitable basis between the Construction Code Authority and such Divisional Code Authorities as shall cooperate in procuring the registration of such work or services.

(*e*) It may propose modifications of or amendments to the general provisions of this Code which, after submission to the Divisional Code Authorities affected thereby, may be recommended to the President for his approval, and upon such approval, following such notice and hearing as he may prescribe, shall have full force and effect as provisions hereof.

(*f*) It may exercise the foregoing powers and duties in any division of the industry for which no Divisional Code Authority shall have been established; and, if in its opinion the policies of the Act require, it may recommend to the Administrator that an additional chapter of this Code be established for any such division of the industry.

(*g*) Its members or authorized representatives may attend meetings of any Divisional Code Authority, and it may at any time make appropriate recommendations to the Administrator to insure the proper functioning or representative character of any such Divisional Code Authority.

(*h*) It may secure an equitable and proportionate payment of the expenses of its establishment, maintenance and activities from members of the industry.

B. DIVISIONAL CODE AUTHORITIES

Section 1. Procedure for Establishing

There shall be established for each division of the industry a Divisional Code Authority which shall, within the limitations provided herein, administer within such division, this Code and the provisions of any chapter hereof applicable specifically to such division. The procedure for establishing each such Divisional Code Authority shall be defined in the chapter pertaining to that division of the industry. The non-voting members appointed by the Administrator to the Construction Code Authority (or their proxies appointed by the Administrator) may serve in like capacity with respect to any Divisional Code Authority.

Section 2. Powers and Duties

Each such Divisional Code Authority shall, in addition to any other powers and duties conferred upon it in the chapter applicable to its division, have the following powers and duties:

(*a*) It may establish rules and regulations for the conduct of its affairs and may appoint such committees, agencies and representatives and delegate to them such of its powers and duties as it may deem necessary for the proper discharge of its functions hereunder.

(*b*) It shall cooperate with the Administrator and with the Construction Code Authority in making investigations as to the functioning and observance of any provisions of this Code, at its own instance or on complaint of any person affected, and shall collect from members of the industry and compile and furnish to the Administrator, and to the Construction Code Authority, any reports and other information required under the Act. Except as may be required for the effective enforcement of the provisions of this Code, the reports of individual members of the division required shall be confidential and only compiled summaries of such individual reports shall be furnished.

(*c*) It shall study the provisions incorporated in this Code applicable to its own division, and the operation thereof, and after submission to the Construction Code Authority may make such recommendations to the Administrator as it deems desirable for modification or addition thereto. Such recommendations, upon approval of the Administrator after such notice and hearing as he may prescribe, shall become a part of this Code and have full force and effect as provisions hereof.

(*d*) It shall receive and so far as possible adjust all complaints as to trade practices between members of its division in the operation of the provisions of this Code applicable to its division.

(*e*) It may secure an equitable and proportionate payment of the expenses of its establishment, maintenance and activities from members of its division of the industry.

C. REPRESENTATION AND MEMBERSHIP

Section 1. Modification in Selection

In order that the Construction Code Authority and the Divisional Code Authorities shall at all times be truly representative, respectively, of the industry and of the divisions, and in other respects comply with the provisions of the Act, the Administrator may provide such hearings as he may deem appropriate; and thereafter, if he shall find that the Construction Code Authority or any Divisional Code Authority, is not truly representative or does not in other respects comply with the provisions of the Act, he may require an appropriate modification in the method of selection of the Construction Code Authority, or of any Divisional Code Authority, as the case may be.

Section 2. General Requirements

The sponsors of this Code who participate in the selection of any Code Authority or administrative agency provided for herein, shall submit to the Administrator true copies of their Articles of Association or Incorporation, Constitution and By-Laws, and other pertinent rules and regulations and any amendments when made thereto, together with such other information as to organization, membership, and activities as the Administrator may deem necessary.

In addition to the information required to be submitted by members of the industry or its divisions under this Code, there shall be furnished to government agencies such statistical information as the Administrator may deem necessary for the purposes recited in Section 3 (*a*) of the Act. Except as may be required for the effective enforcement of the provisions of this Code, the reports of individual members of the industry required under this Code shall be confidential and only compiled summaries of such individual reports shall be published.

Nothing contained in this Code shall constitute the members of the industry or the members of the Construction Code Authority or of a Divisional Code Authority or any committee or agency thereof partners for any purpose. No member of the industry shall be liable in any manner to anyone for any act of any other member of the industry or any agent or employee thereof pursuant to this Code. No member of such a Code Authority, committee or agency, shall be liable in any manner to anyone for any act of any other member, officer, agent or employee of such Code Authority, committee or agency. Nor shall any member of any such Code Authority, committee or agency, exercising reasonable diligence in the conduct of his duties hereunder, be liable to anyone for any action or omission to act under this Code, except for his own wilful misfeasance or nonfeasance.

ARTICLE V. APPEALS

Section 1. Construction Appeals Board

The Construction Code Authority shall establish, under rules and regulations prescribed by and subject to the approval of the Administrator, a suitable agency to be known as the Construction Appeals Board, to consist of one architect, one professional engineer, three general contractors and four special contractors.

Section 2. Powers of Board

The Construction Appeals Board shall hear and determine the appeals referred to in Section 3 of this Article and shall likewise be empowered to determine, in the event of a conflict between the provisions of the various chapters hereof, applicable to specific divisions or subdivisions of the industry, which of such chapter provisions shall govern.

Section 3. Complaint within Division

Any interested party shall have the right of complaint to the appropriate Divisional Code Authority established for any division of the industry, and of a prompt hearing and decision in respect of any decision, rule, regulation, order or finding made by such Authority or its committees or agencies, under such rules or regulations as may be prescribed therefor and the decision of said Authority thereon may be appealed by any interested party to the Construction Appeals Board.

Section 4. Appeal to Administrator

Any interested party shall have the right of appeal to the Administrator, under such rules and regulations as he may prescribe, in respect of any decision, rule, regulation, order or finding made by the Construction Code Authority or the Construction Appeals Board.

Section 5. Limitation of Power

No decision, rule, regulation, order or finding shall be made by any Code Authority or other administrative agency, excluding the Boards provided for in Article III hereof, provided for in or pursuant to this Code, whether made pursuant to the foregoing sections of this Article V or otherwise, of or in any dispute between employers and employees, or between groups of employees, including, in such last-named classes of disputes, any case or controversy whose determination would directly involve or affect any dispute between groups of employees as to the right to perform specific types of work or operations, including cases commonly known as trade jurisdictional disputes.

ARTICLE VI. ADJUSTMENTS

In the event that any member of the industry subject to this Code shall have contracted before June 16, 1933, to purchase goods, structures, or parts thereof at a fixed price for delivery after that date and prior to the expiration of this Code, it is equitable and promotive of the policies of the Act that an appropriate adjustment of said price be made to meet any increase in cost to the seller caused by the seller's having signed the President's Reemployment Agreement or having become bound by any code of fair competition approved by the President; provided, however, that in view of the fact that construction operations customarily involve the furnishing of various goods and structures, or parts thereof by a continuous series of independent long-term contracts and agreements at fixed prices between various parties, such as owners (including government departments), contractors, subcontractors and others, such adjustments may be made contingent upon similar appropriate adjustments to be made by all other parties thus participating, from and including the initial vendor of such goods and structures or parts thereof to and including the owners of the works or structure upon which they are used.

ARTICLE VII. COMPETITIVE BIDDING PRACTICES

Section 1. Competitive Bidding Defined

(*a*) The term "competitive bidding" as used herein shall mean the submission at or before a definite predetermined time of comparable proposals by two or more invited persons to an awarding authority to execute a specific program of work, furnishing a definite service or supplying a material specifically required for a particular project at a stipulated price. This does not include furnishing quotations on standard products.

(*b*) The term "awarding authority" as used herein shall mean any member of the industry who may upon competitive bidding award contracts.

Section 2. Bid Peddling and Bid Shopping

(*a*) The practices commonly known as "bid peddling" or "bid shopping" are recognized as unfair and are prohibited. Bid peddling in effect means the offering by the bidder prior to the making of an award of a substitute bid or price lower than the one originally bid without a commensurate decrease in the requirements of the job. The correction of the abuses resulting from such practice is obtainable by regulation restricting or controlling bidders.

(*b*) Bid shopping in effect means the effort on the part of the awarding authority to induce a bidder prior to the making of the award to lower his original bid price without a commensurate decrease in the requirements of the job. The correction of the abuses resulting from such practice is obtainable by regulation restricting or controlling the awarding authority.

Section 3. Limitation on Bids and Alternates

(*a*) Since it is recognized that the preparation of a bid is a service involving an expense to the bidder and that the inviting of an unreasonable number of bids is an economic waste, the awarding authority shall not invite an unnecessary number of bids.

(*b*) Only a limited number of alternate proposals shall be required in connection with any bid, and no alternate proposal of a bidder shall be considered by the awarding authority, unless the privilege of alternate proposals is extended to all bidders.

Section 4. Uniformity of Information

The awarding authority shall make available uniformly to all bidders, plans and/or specifications or other requisite information which shall be sufficiently complete to enable each bidder to prepare a definite bid in accordance with the regulations herein provided for. He shall prescribe terms of competition which shall insure parity of standing to all bidders.

Section 5. Qualification of Bidders

The awarding authority shall not invite bids from a bidder unless such bidder shall have demonstrated to the satisfaction of the awarding authority that he is competent technically and financially to perform the work, and the ability of a bidder to obtain a performance bond shall not be regarded as the sole test of such bidder's competency.

Section 6. Award at Original Price

An award if made shall be made at the bidder's original bid price. It is recognized that competition based solely on price is sometimes unfair and accordingly the awarding authority may make an award to a competitive bidder other than the lowest bidder provided the award is made at such competitor's original bid price.

Section 7. Receipt of Bids

The awarding authority shall designate a specific hour and place for receiving competitive bids. All bids to be submitted by subcontractors shall be delivered to the contractor at least 24 hours prior to the time set for the receipt of the bid of said contractor by the awarding authority. Bids received after such time or from uninvited bidders shall be returned unopened. All bids shall be required to be signed by a duly authorized representative of the bidder and enclosed in a sealed envelope on the outside of which shall appear its identification as a bid for the particular job.

Section 8. No Influencing of Bidders

The awarding authority shall not at any time prior to the specified time for the receipt of bids convey to any bidder information relating to the price or terms of any other bid in order to influence the price or terms of such bidder.

Section 9. Collusion Prohibited

There shall be no collusion between the awarding authority and any bidder, nor between the different bidders in the preparation of any bid. The awarding authority shall not use any bid which is so unduly low as to indicate an error or mistake in estimating without first giving the bidder the opportunity of demonstrating by cost sheets or other methods the correctness of the bid that he has submitted.

Section 10. Time Limit on Awards

The awarding authority shall make an award or reject all bids for the principal contract with the owner within twenty (20) days after the stipulated time for the receiving of bids except where an extension of time has been requested from the bidders and has been consented to by two or more bidders. In the case of bids conditioned upon the award of a previous contract, each succeeding awarding authority shall make an award or reject all bids within thirty (30) days after the award of such previous contract except as to such bidders as shall agree to an extension of time. The right to reject any or all bids may be reserved by the awarding authority, and such rejection shall be made in writing. Where all bids are rejected, bids shall not be again invited or submitted for the mere purpose of obtaining a lower or revised price or prices for substantially the same work previous to the elapse of ninety (90) days from the date of such rejection, except there be a substantial change in the plans and/or specifications, or except there be evidence of collusion, or except there be such a marked difference between the bids submitted and the awarding authority's estimate as to the valuation of the work as would indicate to the awarding authority and his Code Authority the necessity of new bids in order to secure fair competition.

Section 11. Naming of Subcontractors

Before making an award the awarding authority may require any bidder to name the subcontractors whom such bidder intends to employ for the various divisions of the work bid upon.

Section 12. Rebates, Refunds and Discounts

The awarding authority shall not accept rebates, refunds, discounts, or other special allowances or services from a bidder unless included by the bidder in his original bid.

Section 13. Owner's Compliance

The various divisions and subdivisions of the industry may provide in the chapters specifically applicable to such divisions or subdivisions, that members of the division or subdivision shall not submit a competitive bid, as defined in Section 1 (*a*) of this Article, to an owner or any other person, corresponding to an awarding authority as herein defined unless such owner or other person agrees to comply with the regulations provided herein governing an awarding authority.

Section 14. Checking Bids

In order to enforce the practice of fair competitive bidding, the Divisional Code Authorities shall provide, if no such method is provided in the chapter applicable to such division, a method satisfactory to the Construction Code Authority for checking bids submitted by members of such division either by designating a depository for the filing of duplicate bids or by some other acceptable method. The Construction Code Authority may require such changes in any such method as may be necessary to prevent conflict between the various methods which may be adopted by the various Divisional Code Authorities.

ARTICLE VIII. GENERAL

Section 1. Labor Provisions of Act

Employees shall have the right to organize and bargain collectively through representatives of their own choosing, and shall be free from the interference, restraint, or coercion of employers of labor, or their agents, in the designation of such representatives or in self-organization or in other concerted activities for the purpose of collective bargaining or other mutual aid or protection; no employee and no one seeking employment shall be required as a condition of employment to join any company union or to refrain from joining, organizing or assisting a labor organization of his own choosing; employers shall comply with the maximum hours of labor, minimum rates of pay, and other conditions of employment, approved or prescribed by the President.

Section 2. Reclassification of Employees

Employers shall not reclassify employees or duties of occupations performed by employees with the intent or for the purpose of defeating the purposes of the Act.

Section 3. Federal or State Laws

No provision of this Code shall supersede any state or Federal law imposing more stringent requirements on employers regulating the age of employees, wages, hours of work, or health, fire or general working conditions than those contained in this Code.

Section 4. Monopolies

No provision of this Code shall be so construed or applied as to permit or promote a monopoly or a monopolistic practice, or to eliminate or oppress or discriminate against small enterprises.

Section 5 Additional Chapters

Additional chapters to this Code may be submitted to the Construction Code Authority for submission by it for the approval of the President but nothing contained herein shall be construed to prevent any representative association or group from submitting any such chapter directly to the President for his approval, provided that the Construction Code Authority, if then established, shall be given an ample opportunity to consider and examine any such chapter prior to its submission to the President to the end that there may be proper coordination within the industry and between its various divisions and subdivisions. Upon approval by the President, such chapter shall become an integral part of this Code the same as if originally included herein, but any exceptions therein to the general provisions of this Code shall apply only to the members of the division, or subdivision of the industry to which such chapter pertains. No specific provision of this Code applicable to its amendment or modification shall constitute a limitation upon any right to propose such amendments or modifications which may be conferred by the Act.

Section 6. Presidential Powers

This Code, and all the provisions thereof, and of any chapter thereof, are expressly made subject to the right of the President, in accordance with the provisions of subsection (*b*) of Section 10 of the Act, from time to time to cancel or modify any order, approval, license, rule or regulation issued under Title I of the Act and specifically, but without limitation, to the right of the President to cancel or modify his approval of this Code, or of any additional chapter thereof or any conditions imposed by him upon such approval.

Captions, where omitted in official draft, have been added by the Construction League of the United States.

Engineering Division of the Construction Industry Code

WHEN consideration is given to the matter of special processes or special equipment, more particularly patented processes or equipment, it appears that engineering enters, or may enter, deeply into design as related to construction. With this idea in mind, NRA officials developed, as of January 30, 1934, a draft of a chapter of the Construction Industry Code wherein engineering service accessory to construction is divided into six so-called "methods of practice."

A general definition of "engineering service" is indicated as entering all "methods of practice," briefly paraphrased as follows:

"A," wherein the engineer has no financial self-interest **in the** type of design and there is no construction performance;

"B," wherein the engineer has no financial self-interest in the type of design but where there is construction performance;

"C," wherein the engineer has financial self-interest in the design and in the construction performance with respect to the type of major elements of the work or the use of particular processes or particular equipment;

"D," wherein the service is primarily for the purpose of obtaining the use of particular processes or the installation of particular equipment;

"E," in connection with the inspection of materials, more particularly at points of origin; and finally

"F," when applicable to those engaged in surveying as it is accessory to construction.

That the problem is recognized as inherently difficult of solution is evidenced by the fact that two methods of selection of the Code Authority members are suggested. Membership on any Code Authority must consist of employers properly representative of its several business interests, subject to the operation of its code. In each of the suggested methods of selection of members of the Authority the Executive Committee of the Society is counted upon to supply employers of the professional engineer type. Even NRA officials themselves have indicated that probably neither of the methods suggested would be wholly satisfactory to all concerned.

As at present understood, the draft is an attempt to observe the various conditions under which engineering enters the field of construction. There is little doubt that the suggested form will be subject to some modification. It is now undergoing study by the members of the Board of Direction.

The proposed Code for Engineers, or for engineering, has passed through stage after stage in tentative form, and it has been the policy of this publication to spread at length only such of these drafts as attain a formal character. In line with this policy, the suggested draft is not here reproduced. Copies of the draft may be obtained at Society Headquarters by any who are interested in studying it.

"Construction Comes of Age"

Under this caption a brief summary of the efforts and accomplishments in effecting the newly approved Construction Industry Code is given in the February 1934 issue of *Construction*, official bulletin of the Construction League of the United States. It is repeated here:

> "The Blue Eagle came to roost on the steel skeletons and mixers of the construction industry on January 31 when President Roosevelt approved Chapter I of the industry's Code of Fair Competition. This constitution for construction was conceived last July and is the reward of some twenty national associations, cooperating with the Construction League to weld what has heretofore been one of the least coordinated industries of the country.
>
> "The six months have been punctuated by strong opposition, which necessitated the reconvening of the public hearing on the code in November. After a thorough airing of all viewpoints, a committee was appointed by the Administrator to iron out differences. Out of this conference has come the final document, which is remarkable for the manner in which it coordinates the designers and erectors of a construction project.
>
> "The task was not an easy one; late in July the first code was drafted. Since that time it has been necessary to correlate the interests of every type of designer and constructor, of groups which have always been far removed from each other in thought and function. The wholeheartedness and unselfishness with which these divisions of the industry have brought their intelligence and influence to the fight for coordination is perhaps the most significant phase of the development of the Construction Code.
>
> "Self-interest was subordinated to the welfare of the industry as a whole; summer, fall and winter saw, not separate groups of general contractors, painters, architects, engineers, plumbers, and electricians, but an efficient unit of members of the construction industry guarding the welfare of the whole, moulding the bayonets of ruinous competition into a common plowshare that all alike might share the benefits of recovery. Their efforts have left an indelible mark on construction; the sections of the code governing bidding, for example, are a lasting norm of fair competition.
>
> "Thus the first step towards real recovery has been accomplished. An important job lies ahead in the administration of the code. The groups in Washington have turned their attention to this, and with the same coöperation that has been evident in the past, will undoubtedly be prepared to undertake the administrative program when the code becomes effective on March 2."

Meeting of the Outgoing Board of Direction—Secretary's Abstract

On January 15 and 16, 1934, the Board of Direction met at Society Headquarters with President Alonzo J. Hammond in the chair; and present George T. Seabury, Secretary; Otis E. Hovey, Treasurer; and Messrs. Black, Buck, Crocker, Enger, Gregory, Henny, Herrmann, Holleran, Horner, Jonah, Lupfer, Mead, Mendenhall, Morse, Noyes, Perry, Reed, Riggs, Sanborn, Sherman, Stevens, Stuart, and Tuttle. (The members of the incoming Board were present by invitation as observers for all or parts of the sessions.)

Annual Report of the Board of Direction

The Annual Report of the Board of Direction was presented and adopted. Extracts from this report were featured in the February 1934 issue.

Approval of Minutes of Board

The minutes of the meeting of the Board of Direction held on September 25 and 26, 1933, were approved.

Approval of Minutes of Executive Committee

The minutes of the meeting of the Executive Committee held on December 15, 1933, were approved and the actions outlined therein were adopted as the action of the Board.

Amendment to Article V, Section 2, Paragraph (h) of the By-Laws

Article V, Section 2, Paragraph (*h*) of the By-Laws was amended as follows:

Paragraph (*h*), now reading as follows: [Note: Prefacing clause remains: "The qualifications required of a proposed Student Chapter shall include":] "(*h*) The faculty sponsor of the Student Chapter shall be a Corporate Member of the Society," was stricken out and the following was substituted therefor:

"(*h*) A faculty adviser to the Student Chapter whose duties it shall be to consult with and advise the Student Chapter on matters relating to the general conduct of the Chapter. The faculty adviser shall be a Corporate Member of the Society and shall be a member of the faculty of the engineering school at which the Student Chapter is organized."

Engineers' Council for Professional Development

It was reported that the First Annual Report of the Engineers' Council for Professional Development (E.C.P.D.) had been received (the Society's representatives in this connection are Messrs. J. Vipond Davies, Harrison P. Eddy, and Charles F. Loweth) and contained the following recommendations, which were acted on separately as follows:

1. Accrediting Agency for Engineering Schools. The E.C.P.D. voted to recommend to the participating bodies that E.C.P.D. be authorized to undertake a program of accrediting the curricula of the various schools of engineering which are deserving of approval as representing sound and adequate instruction in various professional fields of engineering. The proposed undertaking was approved.
2. Minimum Definition of an Engineer.
3. Uniform Grades of Society Membership.

The E.C.P.D. reported that it realized that the recommendations covering minimum definition of an engineer and uniform grades of Society membership deal with the fundamental structure of the engineering societies and the profession; and it further suggested, as an intermediate step and before the participating bodies take up these recommendations for formal action, that each participating body designate two members from its governing body to meet with E.C.P.D. and become familiar with the material upon which it based its conclusions in these matters and report back.

The President was authorized to appoint the two representatives as suggested.

Subsequently, Messrs. John P. Hogan and Henry J. Sherman, Members Am. Soc. C.E., were appointed.

Federal Securities Act of 1933

A report was presented from a Special Committee of the American Institute of Consulting Engineers regarding the Federal Securities Act of 1933, which the council of the institute had adopted on December 13, 1933.

It was decided to cooperate with the American Institute of Consulting Engineers along the lines of the report, possibly in bringing to the attention of the Federal Trade Commission and the proper congressional committees having this matter in hand the importance of revisions in principle as suggested in the report, and possibly later to recommend specific revisions in the language of the act.

Civil Works Administration: Desirability of Securing Recognition of Engineers Working on Projects

In the matter of securing proper recognition for engineers working on CWA projects, especially in regard to compensation, the President was authorized to appoint a committee to contact with CWA officially.

Incoming President Eddy, Secretary Seabury, and Edwin F. Wendt, M. Am. Soc. C.E., were appointed as such committee.

Code of Fair Competition for the Engineering Division of the Construction Industry

F. H. Weed, M. Am. Soc. C.E., Assistant Deputy Administrator, NRA, appeared before the Board by invitation and explained the new form of the proposed Code of Fair Competition for the Engineering Division of the Construction Industry.

Joint Committee on Water Pollution

A progress report was received from the Joint Committee on Water Pollution composed of members of this Society and the American Institute of Chemical Engineers. Excerpts from the report appear elsewhere in this issue. The committee was continued.

Communication from United Engineering Trustees, Inc.

Director Mead, one of the Society's representatives on the United Engineering Trustees, Inc., presented a summary of recent activities of that body which was ordered received and filed. An abstract of this report will be found on another page.

Communication from Engineering Foundation

Vice-President Tuttle, one of the Society's representatives on the Engineering Foundation, presented a summary of recent activities of the Engineering Foundation which was ordered received and filed. A condensed summary is noted in a separate item in this issue.

Committee on Publications

The Committee on Publications presented a report reviewing its work for the year. The committee was pleased to be able to report the maintenance of a favorable condition as to promptness of printing papers. Two volumes of TRANSACTIONS were issued in 1933, one comprising the papers on the George Washington Bridge in connection with which the Port of New York Authority cooperated in every possible way including financially. Several adjustments have been made during the year in the procedure of issuing Society publications, resulting in increased efficiency and reduced expense. The committee also submitted a report covering Manuals showing the present status of all manuscript material.

Committee on Professional Conduct

The Committee on Professional Conduct reported on five matters, including three questions in ethics.

Committee on Districts and Zones

The boundaries of the Districts and Zones as at present defined were adopted as those which are to be applicable for the year 1934.

Survey of Student Chapters

The Committee on Student Chapters presented a detailed report covering its activities during the year 1933 and a statistical report for the 106 Chapters in the academic year 1932–1933. The total reported membership was 4,361, only slightly less than the previous total of 4,390. There was, however, a marked increase in total attendance at meetings, from 36,649 in 1931–1932 to 42,665 in 1932–1933.

Attention was called to the few Chapter delinquencies in regard to annual reports and financial arrears which mar the otherwise splendid record of the Chapters. The probationary status of the Chapter at Pennsylvania Military College was lifted with special commendation to the Chapter for its excellent record to date. In regard to the eligibility of Student Chapter members for remission of dues, the committee recommended that in the case of graduate students the remission of the first year's dues should apply only when the student continues and completes his graduate studies for the master's degree during the academic year next following the conferring of his baccalaureate degree.

Note was also taken of District Group Conferences in Philadelphia and New York, the admission of six new Chapters during the year, and a reiteration of the previously stated policy of opposing the administration of Student Chapters as honor societies.

Reports from Advisory Committees

The Board received reports from its six Board committees; from nine advisory, administrative, and professional committees; from one special committee; from one research committee; and from one joint committee.

Applicants for Membership to Be Required to Submit Photographs

It was decided that hereafter each applicant for admission to the Society be required to furnish a photograph with his application.

University of Mississippi Restored to List of Accredited Schools

Favorable action was taken in connection with the application from the University of Mississippi for reinstatement as an accredited school. Director Enger reported that as instructed he had visited the university and made an inspection of facilities. The Committee on Accredited Schools also recommended the reinstatement of this university.

Resolution Adopted Protesting Against Proposed Transfer of Coast and Geodetic Survey from Department of Commerce to Navy Department

A resolution of protest, similar to one recently adopted by the American Engineering Council, with respect to the proposed transfer of the Coast and Geodetic Survey work from the Department of Commerce to the Navy Department was adopted, as featured elsewhere in this issue.

Los Angeles Section: Resolution Urging Inclusion in Federal Budget of Funds for Work of Division of Irrigation, Bureau of Agricultural Engineering, U. S. Department of Agriculture

A resolution, similar to one recently adopted by the Los Angeles Section of the Society, was adopted by the Board urging the inclusion in the Federal Budget of funds for work of the Division of Irrigation of the Bureau of Agricultural Engineering of the U. S. Department of Agriculture. This resolution is given in detail elsewhere in this issue.

1934 Summer Convention—Vancouver

It was decided to hold the 1934 Convention in Vancouver, B.C., late in June or early in July, the exact date to be fixed by the Executive Committee.

Proposed Budget for 1934

The proposed budget for 1934, as recommended by the Executive Committee, was discussed in detail, amended somewhat, and recommended to the incoming Board for adoption.

Other routine matters were considered and action taken.

Farewell Speeches

Those members of the Board whose terms expired expressed their regret at leaving the Board.

Meeting of the Incoming Board of Direction—Secretary's Abstract

The Board of Direction met at the Headquarters of the Society on January 18, 1934, with President Harrison P. Eddy in the chair; and present George T. Seabury, Secretary; Otis E. Hovey Treasurer; and Messrs. Ammann, Barbour, Black, Crocker, Enger, Etcheverry, Gregory, Hammond, Hogan, Horner, Lupfer, McDonald, Noyes, Perry, Reed, Riggs, Sanborn, Sherman, Stevens, Trout, and Wilkerson.

University of Puerto Rico

On recommendation of the Committee on Accredited Schools, the University of Puerto Rico was recognized as an accredited school.

Committee on Hydraulic Research Authorized

The President was authorized to appoint a Committee on Hydraulic Research.

Committee on Flood Protection Data Authorized

The President was authorized to appoint a Committee on Flood Protection Data.

Budget for 1934

The Budget for 1934, as amended in several administrative details by both the outgoing and incoming Boards, was adopted.

Special Committees

The following personnel for committees for 1934 was approved, the President being given authority to complete it and to fill vacancies where necessary.

Executive Committee: Harrison P. Eddy, Chairman; John P. Hogan, Vice-Chairman; Herbert S. Crocker, Alonzo J. Hammond, and Edward P. Lupfer.

Committee on Honorary Membership: Harrison P. Eddy, Chairman; Herbert S. Crocker, F. O. Dufour, H. D. Dewell, Alonzo J. Hammond, John P. Hogan, and Frank G. Jonah.

Committee on Districts and Zones: F. O. Dufour, Chairman; Robert Hoffmann, B. A. Etcheverry, and Frederick H. McDonald.

Committee on Professional Conduct: J. C. Stevens, Chairman; J. P. H. Perry, Ralph J. Reed, Henry E. Riggs, and James F. Sanborn.

Committee on Publications: John H. Gregory, Chairman; Frank A. Barbour, W. W. Horner, Edward P. Lupfer, and Henry J. Sherman.

Committee on Membership Qualifications: M. L. Enger, Chairman; E. B. Black, Robert Hoffmann, Frederick H. McDonald, and E. N. Noyes.

Committee on Research: Thaddeus Merriman, Chairman, term ending January 1935; George E. Beggs, Vice-Chairman, term ending January 1936; Thorndike Saville, term ending January 1937; Fred C. Scobey, term ending January 1938; and Director John H. Gregory, Contact Member.

Committee on Local Sections: N. T. Veatch, Jr., Chairman, term ending January 1935; A. T. Dusenbury, term ending January 1936; V. H. Cochrane, term ending January 1937; Andrew P. Rollins, term ending January 1938; and Director E. B. Black, Contact Member.

Committee on Juniors: H. P. Treadway, Chairman, term ending January 1935; J. T. L. McNew, term ending January 1936; Charles M. Davis, term ending January 1937; F. W. Green, term ending January 1938; and Director E. N. Noyes, Contact Member.

Committee on Student Chapters: T. A. Leisen, Chairman, term ending January 1935; C. C. Williams, term ending January 1936; R. L. McCormick, term ending January 1937; H. W. Hanly, term ending January 1938; and Director T. J. Wilkerson, Contact Member.

Committee on Engineering Education: O. M. Leland, term ending January 1935; Clarence L. Eckel, Chairman, term ending January 1936; R. H. Ford, term ending January 1937; Robert L. Sackett, term ending January 1938; and Director Henry Earle Riggs, Contact Member.

Committee on Public Education: Abel Wolman, Chairman, term ending January 1935; D. H. Sawyer, term ending January 1936; L. J. Johnson, term ending January 1937; Van Tuyl Boughton, term ending January 1938; and Director Henry J. Sherman, Contact Member.

Committee on Legislation: R. W. Lawton, Chairman, term ending January 1935; E. J. Schneider, term ending January 1936; W. W. Crosby, term ending January 1937; R. A. Hoffman, term ending January 1938; and Director Ralph J. Reed, Contact Member.

Committee on Registration of Engineers: R. E. Warden, Chairman, term ending January 1935; W. T. Chevalier, term ending January 1936; Charles H. Paul, term ending January 1937; James L. Ferebee, term ending January 1938; and Director W. W. Horner, Contact Member.

Committee on Fees: Frank A. Marston, Chairman, F. H. Fowler, Samuel A. Greeley, and Director J. P. H. Perry, Contact Member.

Committee on Salaries: Ernest P. Goodrich, Chairman; E. O. Griffenhagen, A. B. McDaniel, W. F. Reeves, Arthur Richards, and Director O. H. Ammann, Contact Member.

Committee on Regional Meetings:

Annual Meeting: John P. Hogan, Chairman; O. H. Ammann, J. P. H. Perry, James F. Sanborn, and C. E. Trout.

Spring Meeting: F. O. Dufour, Chairman; John H. Gregory, Frederick H. McDonald, E. N. Noyes, and Henry J. Sherman.

Summer Convention: H. D. Dewell, Chairman; E. B. Black, B. A. Etcheverry, Ralph J. Reed, and J. C. Stevens.

Fall Meeting: Frank G. Jonah, Chairman; F. A. Barbour, M. L. Enger, Robert Hoffmann, W. W. Horner, Edward P. Lupfer, Henry E. Riggs, and T. J. Wilkerson.

Committee on Technical Procedure: Harrison P. Eddy, Chairman; William Bowie, Arthur C. Everham, John H. Gregory, George H. Herrold, Charles Gilman Hyde, E. W. James, Charles Keller, F. R. McMillan, Thaddeus Merriman, C. M. Spofford, J. C. Stevens, C. E. Trout, and George T. Seabury, Secretary.

Committee on Professional Activities: Harrison P. Eddy, Chairman; O. H. Ammann, E. B. Black, W. W. Horner, E. N. Noyes, J. P. H. Perry, Ralph J. Reed, Henry E. Riggs, Henry J. Sherman, T. J. Wilkerson, and George T. Seabury, Secretary.

Committee on Accredited Schools: Harold A. Thomas, Chairman, term ending January 1935; Milo S. Ketchum, term ending January 1936; J. G. Bennett, term ending January 1937; Franklin Thomas, term ending January 1938; and Director M. L. Enger, Contact Member.

Committee on Alfred Noble Prize: This committee is made up of representatives from five societies, the representative from the Civil Engineers (Charles M. Spofford) being the chairman.

Committee on Society Property: Lincoln Bush, Chairman; George S. Davison, and Francis Lee Stuart.

Committee on Public Works: Malcolm Pirnie, Chairman; John P. Hogan, and Alonzo J. Hammond.

Advocating Budget Provision for Division of Irrigation, U. S. Department of Agriculture

There seems to be danger of curtailing or discontinuing the work of the Division of Irrigation, Bureau of Agricultural Engineering, U. S. Department of Agriculture. This is implied in the failure to include any appropriation for the division in the budget for the coming year. Believing that this would be a distinct loss to the country, the Board of Direction at its January 15, 1934, meeting, adopted the following resolution. A similar resolution has been adopted by the Los Angeles Section.

"Whereas, It has been brought to the attention of the Board of Direction of the American Society of Civil Engineers that no provision has been made in the proposed 1935 budget for continuing the work of the Division of Irrigation, Bureau of Agricultural Engineering, U. S. Department of Agriculture, which is conducting research investigations pertaining to problems relating to irrigated-agriculture, such as: (*a*) utilization of water in irrigation, including duty of water; evaporation; pumping for irrigation; reclamation and management of alkali lands, etc.; (*b*) irrigation conduits and structures, including design and invention of apparatus; silt in streams and reservoirs; canal operation, maintenance, and improvement; flow of water in ditches, pipes, etc.; storage of water underground; control of gravel in open channels, etc.; and (*c*) customs, regulations, and laws relating to irrigation, including financial rehabilitation of irrigation enterprises; cost of irrigation water, and policies governing ownership of return waters from irrigation, and

"WHEREAS, The work of this division (formerly known as Irrigation Investigations, first under the Office of Experiment Stations and later under the Division of Agricultural Engineering of the Bureau of Public Roads), which has been carried on for over 30 years, is of great value to engineers, farmers, and the general public; and most of its present studies, to be of further value, should not be interrupted at this time but be continued for a period of years, and

"WHEREAS, The publications of this organization giving the results of experiments are invaluable to irrigation, hydraulic, and civil engineers in their practice in connection with agriculture, and

"WHEREAS, The Division of Irrigation is carrying on experiments and assembling and collecting data which undoubtedly will not be continued by any other agency, therefore be it

"*Resolved*, That the Board of Direction of the American Society of Civil Engineers urges the President and the Congress of the United States to include in the 1935 budget sufficient funds to continue the irrigation investigations of the Division of Irrigation, Bureau of Agricultural Engineering, U. S. Department of Agriculture, and be it further

"*Resolved*, That a copy of this resolution be forwarded to the Secretary of the U. S. Department of Agriculture."

Recent Activities of United Engineering Trustees, Inc.

A FEW items relative to the United Engineering Trustees, Inc., were reported at the January meeting of the Board of Direction by its representative on that body, covering some of the accomplishments during the period from September to December 1933. Among those which refer to general aspects of work in various branches of engineering may be mentioned the following:

The Trustees renewed their arrangement with the Professional Engineers' Committee on Unemployment to serve as its treasurer.

In September 1933, the United Engineering Trustees, Inc., became a member of NRA under the provisional code of the Real Estate Industry, Office Building Division.

During the summer and fall the Library Fund Committee obtained special contributions to prevent a Library deficit for the year to a total of approximately $3,000.

Sound picture equipment of the most modern type was installed in the motion picture booth in the Engineering Auditorium.

Tax exemption for the Engineering Societies Building has been continued for the year 1934 by the City of New York.

Library hours and services have been somewhat curtailed by enforced reduction of financial support.

Opposition to Transferring Coast and Geodetic Survey to the Navy Department

VIEWING with apprehension the prospect of instituting changes in the administration of the Coast and Geodetic Survey, the Board of Direction at its meeting on January 15, 1934, went on record in favor of maintaining the present status of this engineering activity. A resolution to this effect was adopted in the following terms:

"The public, through the daily press, has been informed that the Federal Administration is contemplating transferring from the Department of Commerce to the Navy Department the U. S. Coast and Geodetic Survey. The Board of Direction of the American Society of Civil Engineers recommends and urges that no such transfer be made.

"In 1921, the Board of Surveys and Maps recommended that there be established a Bureau of Surveys and Maps in which would be concentrated the surveying and mapping agencies of the Federal Government, for the sake of economy and efficiency.

"It is believed this is a far wiser course than any piecemeal transfers, and it is urged that such a bureau be formed at an early date.

"Whether or not such a bureau is formed, the Board of Direction holds the opinion that such work as is performed by the Coast and Geodetic Survey should be carried out under an administration essentially scientifically minded and technically trained along the lines of engineering involved.

"It is for these reasons that the transfer of the U. S. Coast and Geodetic Survey to the Navy Department is considered unwise."

No Change in Boundaries of Districts and Zones

SINCE the Constitution provides that any change in the boundaries of the Districts and Zones of the Society should be made "not later than April 1 in each year," it is customary to announce any such changes soon after the beginning of the year. This is done so that the Corporate Members of the Society will be prepared to indicate their choice of nominees from these Districts and Zones to fill forthcoming vacancies among the Society officers.

After due consideration, the Committee on Districts and Zones has recommended that no change be made in the boundaries for the current year. This report was adopted by the Board of Direction at its meeting on January 16, 1934. Full announcement of the existing division into both Districts and Zones will accompany the First Ballot, when it is mailed to the membership.

Study of Water Pollution

ABOUT a year ago a Joint Committee on Water Pollution, under the sponsorship of the Society and of the American Institute of Chemical Engineers, was established. After thorough study of the problems presented, the committee has determined upon an immediate plan of action, as follows:

1. The preparation of an annotated bibliography dealing with water pollution in general terms, comprising a few paragraphs describing the broad phases of the problem, followed by references to published reports dealing with comprehensive pollution investigations of entire streams, or considerable portions of streams. In addition, the bibliography would similarly treat of the pollution of lakes and coastal waters where pollution originates in the land, and where comprehensive reports have been prepared. In presenting this annotated bibliography on the broad, general problem of water pollution, it was decided to preface the report by a brief statement of the aims and objectives of the committee.
2. The preparation of a limited number of annotated bibliographies dealing with specific domestic and industrial wastes for which practicable means of treatment have been developed. It was agreed that the several reports on these subjects should include the following items:

a) A few paragraphs describing in broad terms the character of the several known practicable treatment processes.

b) A selected and annotated bibliography on the subject.

It has seemed wise to the committee to limit itself for the time being to consideration of the following industrial wastes: pulp and paper wastes, by-products from the petroleum industry, distillery wastes, wastes from packing houses, by-products from the textile industry, by-products from steel mills and coke ovens, and tannery wastes.

The committee further entertains the hope that considerable study may be done during the current year and a progress report submitted.

Officers of the committee include Sheppard T. Powell, of the American Institute of Chemical Engineers, Chairman, and Thorndike Saville, M. Am. Soc. C.E., Secretary. The foregoing information is taken from Secretary Saville's progress report to the Board of Direction, at its January 1934 meeting.

Engineering Foundation Reports Progress

An account of the activities of Engineering Foundation since May 1933 was included in a report to the Board of Direction at its January meeting by its representative on the Foundation. The following excerpt from this communication should be of interest to all members:

"The Summer School for Engineering Teachers, conducted by the Society for the Promotion of Engineering Education, had a successful session at the University of Wisconsin in early July. The Foundation's contribution helped to make this session possible.

"*Engineering: a Career—a Culture* has continued in demand but because of reduced incomes of educational institutions, recent sales have been small. In the past 12 months approximately 30,000 copies have been distributed through various channels, all over our country.

"Studies of objective type tests for entrance to engineering colleges and for aptitudes and achievements in college have continued fruitfully at the School of Mines and Metallurgy, University of Missouri.

. . . . .

"Comprehensive preliminary studies, continued by volunteers, have assembled materials which may be used, when opportunity opens, either for fundamental investigation of transport as a unified service or as the approach to such a basic research into our industrial system.

. . . . .

"Printing of the final report [of the Committee on Arch Dam Investigation] was completed in July 1933. Copies have been distributed to contributors and cooperators. This cloth-bound book of 197 pages is being sold to members of the Founder Societies at $2 and to others at $3. The secretary of the committee, Fred A. Noetzli, M. Am. Soc. C.E., died May 24, 1933. He devoted his energies faithfully, at much personal sacrifice, to the completion of the investigation and the final report.

"The Investigation of the Plastic Flow of Concrete continued at the University of California, adding to valuable long-time tests started in connection with the Stevenson Creek Experimental Dam.

"The Committee on Earths and Foundations has continued its experimental work in this country and abroad with much reduced resources, but nevertheless has made valuable contributions to knowledge through engineering journals, which have brought out helpful discussion and additional information.

. . . . .

"Courses for disengaged engineers in New York City were completed late in May 1933. With cooperation of five metropolitan colleges of engineering and of business administration, the Personnel Research Federation, the Professional Engineers' Committee on Unemployment, technical societies, industries, individuals, and the United Engineering Trustees, Inc., courses in ten subjects were given under the auspices of the Foundation in the Engineering Societies Building to a total of more than 600 engineers, without charge."

A Question of Ethics—Voluntary Testimony Regarding Reduction of Public Service Rate

The following question regarding ethical conduct of engineers has been presented to the Board of Direction's Committee on Professional Conduct. The conclusions of the committee are noted in full:

"*Question:* Should it be considered unethical for an engineer, without invitation, to appear before a city or village council; and, without having made any investigation, to make statements that an appraisal of a utility rendering service to the community would undoubtedly provide a basis for an action before the Public Service Commission that would result in a reduction of rates?

"*Answer:* It is highly unethical to attempt to secure an engineering engagement by such procedure as is indicated in the question. Any attempt to secure work through the creation of public prejudice is improper and unethical. The statement of a conclusion that would probably be reached, before the making of adequate and proper investigation to determine all of the facts upon which to base a correct opinion, is thoroughly unprofessional.

"The fact that an engineer has not been invited to appear before a public body, or any other prospective client, does not necessarily make such an appearance unethical. If a specific piece of work has been decided upon or publicly discussed, and if no engineer has been selected for it, an engineer who seeks it need not wait for an invitation. It is not good practice for an engineer to urge the doing of work, particularly of a similar nature to that named in the question, in a community in which he does not reside, which has not been considered by the residents or authorities of the community."

This reply and the conclusions drawn received the approval of the Board at its January meeting. This disposition should serve as a guide in similar situations.

Additional Members Exempt from Dues

In January 1933, Civil Engineering carried a list of Corporate Members exempt from payment of further Society dues either because they had paid dues continuously for 35 years, or because, having reached the age of 70, they had paid dues continuously for 25 years. This privileged group of members has the distinction of being specially listed in the *Year Book*, pages 115–118 of the 1933 edition. During the past year many others met the constitutional requirements in this respect, and on January 1, 1934, also became exempt from dues. To make the *Year Book* list complete the following names should now be added:

Allen, William Bullard
Anderson, David Guy
Andros, Frederic William
Anthony, Charles Chapman
Barr, Joseph Carroll
Baum, George
Berle, Kort
Betts, Edward Everett
Beugler, Edwin James
Boller, Alfred Pancoast
Branch, Ernest William
Brydone-Jack, Ernest Edmund
Bush, Edward Wallace
Campbell, John Logan
Chase, Marvin
Coffin, Thomas Amory
Cole, Daniel Webster
Condron, Theodore Lincoln
Cornell, Douglas
Cox, Leonard Martin
Crellin, Edward Webster
Cuddeback, Allan Winter
Darling, Fred Steere
Dingle, James Hervey
Eastwood, John Thompson
Flinn, Alfred Douglas
Ford, Robert Henry
Fuller, George Warren
Gardiner, Frederick William
Gildersleeve, Alger Crocheron
Goldsborough, John Byron
Green, Charles Newton
Greenalch, Wallace
Greene, Frederick Stuart
Hammond, George Tillinghast
Harrington, John Lyle
Hill, Henry Francis
Hohl, Leonhard John
LaForge, Frederick William
Lavis, Fred
Lee, Edward Hervey
Lippincott, Joseph Barlow
Llewellyn, Frederick Thomas
Lockwood, James Button Clyde
Lyon, Wallace Chittendon
McMillan, John Gilmore
Main, Charles Thomas
Martin, James William
Mead, Charles Adriance
Morrison, Harry Johnson
Morse, William Prentiss
Oliver, Emery
Pence, William David
Phillips, Howard Crathorne
Poland, William Babcock
Potter, William Bancroft
Preston, Henry Wray
Pruyn, Francis Lansing
Putnam, George Rockwell
Randall, Henry Irwin
Ross, Douglas William
Safford, Arthur Truman
Sarle, Oliver Perry
Sell, William Drumm
Seurot, Paul Albert Nicolas
Sherman, Walter Justin
Shoemaker, Louis Henry
Smith, Albert Henry
Smith, Gilman Walter
Stillwell, Lewis Buckley
Strickler, Gratz Brown
Stuart, Francis Lee
Sullivan, John G.
Swaab, Solomon Mark
Sweitzer, Nelson Bowman
Taber, George Aymar
Taylor, Samuel Alfred
Thompson, Robert Andrew
Thomson, Ernest Burslem
Triest, Wolfgang Gustav
Trundle, Horatio Hartley
Tuzi, *Baron* Taro
Van Etten, Lawrence Edward
Wagner, Joseph Christian
Willis, Paul
Wing, Frederick Kelly
Wolstenholme, Albert

Association with the Society must have meant much to these men. Their active support for the 25 or 35-year period, according to their age, is now to be rewarded by free membership in the Society for the rest of their lives. Those already in the exempt class will welcome those now added to increase their numbers.

A Preview of Proceedings

The March issue of PROCEEDINGS *will contain three interesting and instructive papers. One of these presents a new theory for the design of sheet-pile bulkheads; the second covers an independent research on the movement of sand in models of rivers; and the third describes an exact method of calculating the deflection in suspension bridges. Bringing to a close its eleven and a half years of work, the Society's Committee on Irrigation Hydraulics will publish its final report in this issue of* PROCEEDINGS.

ANALYSIS OF SHEET-PILE BULKHEADS

SINCE the introduction of the deep-arch section of steel sheet piling, the designer has encountered many uncertainties as to the effective passive resistance of the ground and the interlocking efficiency of the piles. Outstanding among the few who have attempted to solve these problems by large-scale experiments, is Prof. O. Franzius, whose work in the Hydraulic Laboratory of the Institute of Technology, in Hanover, Germany, is cited by the author of this article, Paul Bauman, M. Am. Soc. C.E.

Every-day design practice ignores the elastic behavior of the soil and assumes that passive resistance of the soil may be represented by static forces which vary uniformly with the depth, regardless of how much a supporting wall may move. Mr. Bauman's paper is offered with a threefold purpose: namely, to outline and interpret the results of full-sized tests; to offer suggestions for distributing stress in the passive prism between the wall and the surface of rupture; and to present a new theory of the stability of bulkheads considering the elasticity of both soil and wall, and treating the problem as a statically determinate one.

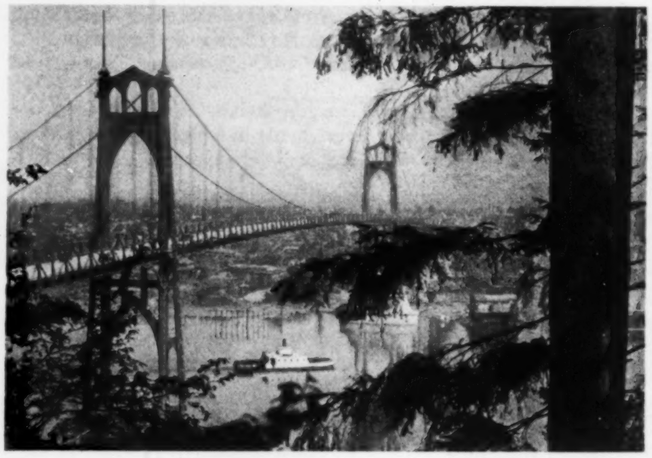
SAND MIXTURES AND SAND MOVEMENTS IN RIVER MODELS

INCREASING interest in river-flow studies, particularly with respect to river models, is tangible evidence of the important work done by the late John R. Freeman, Honorary Member and Past-President Am. Soc. C.E., in advancing this subject as a field for scientific research. The first consequential paper on the subject by one of the Freeman Fund scholars to be published by the Society will appear in the March issue of PROCEEDINGS. This paper, which is by Hans Kramer, Assoc. M. Am. Soc. C.E., has as its source a thesis written by Captain Kramer in partial fulfillment of the requirements for the degree of doctor of engineering at the Technical University at Dresden, Germany. The original thesis, entitled "Modell Geschiebe und Schleppkraft," as well as a translation of it, have been filed in the Engineering Societies Library in New York, N.Y. The paper presented for publication contains the results of independent scientific research in the field of experimental hydraulics. It is divided into the following parts: *geschiebe* mixture for river models; computation of the critical tractive force; and concluding remarks. A new method of attacking the important problem of depth load for *geschiebe* movement is given, and a method of overcoming some important obstacles impeding the progress of the practical hydraulic engineer and experimenter is outlined. It is claimed that the hydraulic engineer can obtain indispensable basic data concerning depth load movement by the simple tests indicated. An understanding of the movability relations between natural and model *geschiebe* enables the experimenter to interpret the results of model tests quantitatively. It is hoped that the suggestions and systematic determinations of data concerning sand load movement may contribute to the advance of science in the field of practical and experimental river hydraulics.

A GENERALIZED DEFLECTION THEORY FOR SUSPENSION BRIDGES

TO MEET the challenge that practical construction and model testing are outstripping the development of analysis, D. B. Steinman, M. Am. Soc. C.E., has spent two years in developing and perfecting "A Generalized Deflection Theory for Suspension Bridges," including the analysis of continuous and multiple spans. The paper by Dr. Steinman on this subject is an important contribution to the correct analysis and economic design of suspension structures. The working formulas previously developed for the simple two-hinged type are here further simplified and for the first time the deflection theory is extended to cover other types of suspension construction, including continuous spans, multiple spans, and multiple spans with tie cables. Although structures of these various types have been built, the theory for their analysis has not been adequate.

The author has aimed at maximum simplicity of formulas and facility of practical application. To show the practical workability of the generalized deflection theory here developed, the paper includes a numerical example of the application of the formulas to the calculation of the stresses and deflections in a continuous suspension bridge of 800-ft main span. The theory is thus found to yield a reduction of 45 per cent in the bending moments as previously computed by the common elastic theory, and the continuous design is found to be more economical or more rigid than the two-hinged type. The application of the generalized deflection theory to the practical problem of multiple-span suspension bridges with tie cables confirms its comprehensiveness and convenience as a foundation for further extensions of suspension bridge theory.



ST. JOHNS BRIDGE OVER THE WILLAMETTE RIVER, PORTLAND, ORE.

Cost, $4,000,000; Main Span, 1,207 Ft Long; Diameter of Twisted-Strand Cables, $16^1/_2$ In.

FINAL REPORT OF THE COMMITTEE ON IRRIGATION HYDRAULICS

IN A BRIEF statement of five pages, the Committee on Irrigation Hydraulics summarizes the work of eleven and a half busy years and thus brings its labors to a close. Properly speaking, this final report is considerably more voluminous than it seems at first glance. The program of the committee has been unique in that it has encouraged individuals to pursue studies independently and to publish their results as independent authors. In this way far more discussion has ensued than would have been the case if such material had been presented in bulk as progress reports.

The five-page final report is an invaluable summary of papers that are available, not only on irrigation but in the whole broad field of hydraulics. For example, in five papers published by the Society under individual authorship, the committee has made available a concise compilation of most of the data on evaporation ever compiled all over the world. This committee has been instrumental in producing some 46 papers and reports, including a bibliography, a list of standard symbols, and a glossary of terms used in hydraulics. Of these, 18 will have been published in TRANSACTIONS, 7 in PROCEEDINGS only, 3 in CIVIL ENGINEERING, 8 as academic theses, and the rest in various governmental and trade publications.

Properly, all this material constitutes the final report of the committee. That printed by the Society, indexed for reference in the most convenient possible form, constitutes about a thousand pages on 11 basic classes of material. These are as follows: evaporation from reservoirs and from soils, canal conversions, water movement and pressure under dams, siphon spillways, the silt problem, chutes and drops, scouring below dams, irrigation deliveries, lateral flow spillways, permissible canal velocities, fishways, and fish screens.

It is obvious that a final report of this kind does not permit of discussion.

Society Appointees

EDWIN F. WENDT, M. Am. Soc. C.E., has been appointed by the Board of Direction, upon nomination of the Engineering-Economics and Finance Division, as a member of the Division's Executive Committee.

FREDERICK S. GREENE, M. Am. Soc. C.E., has been appointed by the Board of Direction, upon nomination of the Power Division, as a member of the Division's Executive Committee.

C. M. SPOFFORD, M. Am. Soc. C.E., has been reappointed to represent the Society on the Alfred Nobel Prize Committee.

LYNNE J. BEVAN AND GEORGE W. BOOTH, Members Am. Soc. C.E., have been appointed Society representatives on the Engineering Societies Library committee to consider the publication of monographs.

News of Local Sections

ALABAMA SECTION

On January 9 the Alabama Section held its annual meeting in Birmingham. At this time the following officers for 1934 were elected: H. H. Houk, President; C. E. McCashin, First Vice-President; W. N. Woodbury, Second Vice-President; and W. H. Caruthers, Secretary-Treasurer.

CENTRAL ILLINOIS SECTION

There were 30 members and guests in attendance at the annual meeting of the Central Illinois Section held in Champaign, Ill., on December 5, 1933. The speaker of the occasion was Harland Bartholomew, of St. Louis, Mo., who discussed the subject, "The Significance of the New Federal Housing Program."

On February 18, the Section converted its regular bimonthly meeting, held at the Inman Hotel in Champaign, into a gala affair in honor of Prof. Hardy Cross, who was recently awarded the Norman Medal. To honor and congratulate Professor Cross, 47 members of the Section and guests from the university and surrounding area were present. The toastmaster was A. N. Talbot, and the following speakers were heard: M. L. Enger, whose subject was "The Society and the Norman Medal"; H. M. Westergaard, who presented the felicitations of the College of Engineering; W. M. Wilson; and A. H. Daniels.

CLEVELAND SECTION

Members of the Cleveland Section who attended the dinner meeting held on January 13, had the opportunity of hearing Alonzo J. Hammond, then President of the Society, speak on the subject of the proposed engineers' code.

CINCINNATI SECTION

A meeting of the Cincinnati Section was called to order at the Engineers Club on January 8, with 34 present. After several committee reports had been heard, the speakers of the evening were introduced. These were Robert Heuck, county auditor, and Raymond W. Renn, a faculty member of the College of Engineering and Commerce of the University of Cincinnati. Both speakers discussed various phases of the subject of revaluation of Hamilton County (Ohio) real estate.

DAYTON SECTION

The Dayton Section held a luncheon meeting at the Engineers Club on December 18, 1933. The matter of the salaries paid engineers engaged on CWA projects was discussed at some length. Then B. T. Schad, Professor of Civil Engineering at the University of Dayton, gave a talk on his experiences during a recent trip to Europe and commented on conditions in the countries visited.

The first session of the Dayton Section for the year 1934 was a luncheon meeting, held at the Engineers Club on January 22. The feature of the occasion was an interesting talk on "Engineering Developments in Alaska," given by George B. Smith, world traveler and lecturer. There were 22 present.

DISTRICT OF COLUMBIA SECTION

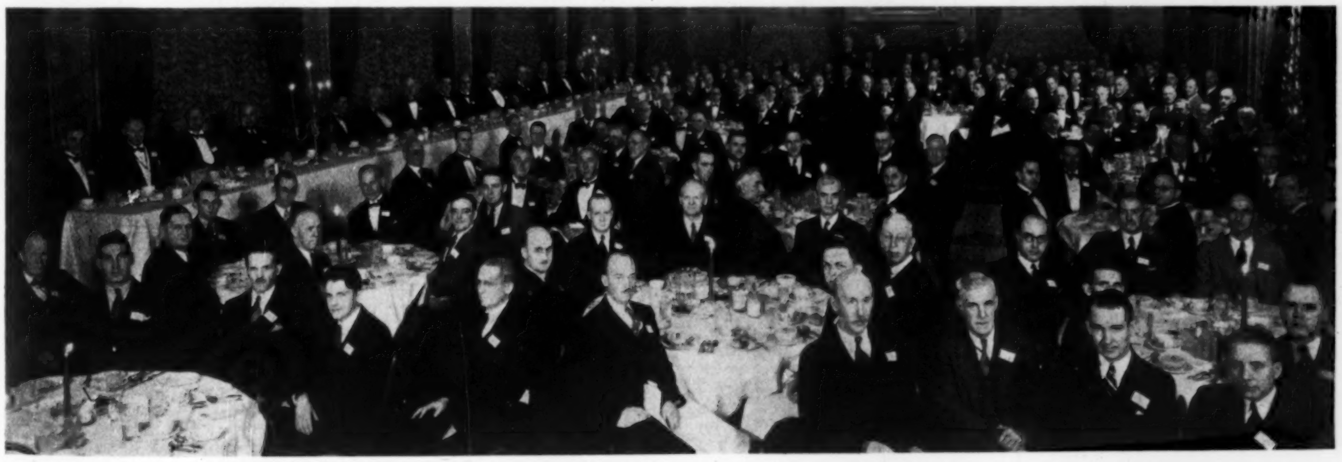
At its annual meeting, held in Washington on January 27, the District of Columbia Section elected the following officers for 1934: F. W. Amadon, President; R. C. Marshall, Jr., Vice-President; and C. G. Paulsen, Secretary-Treasurer.

FLORIDA SECTION

At the annual meeting of the Florida Section the following officers for 1934 were elected: W. W. Fineren, President, and Percy L. Reed, Secretary-Treasurer.

ILLINOIS SECTION

The Illinois Section held its annual meeting at the Engineers Club in Chicago on January 26. After luncheon had been served, Alonzo J. Hammond, Past-President of the Society, gave an interesting account of the Annual Meeting of the Society, recently held in New York City. His talk was supplemented by remarks by M. L. Enger, Professor of Mechanics and Hydraulics at the University of Illinois. The election of officers for 1934, which was held at this time, resulted as follows: S. A. Greeley, President; F. G Gordon, Vice-President; and G. B. Massey, Secretary.



ANNUAL DINNER OF THE DISTRICT OF COLUMBIA SECTION, JANUARY 27, 1934

Metropolitan Section

There were 175 members and guests present at a meeting of the Metropolitan Section held at the Engineering Societies Building in New York on February 21. The chief speaker was Frank E. Winsor, Chief Engineer of the Metropolitan District Water Supply Commission of Massachusetts, who outlined the subject of the legal and engineering problems involved in providing Boston with an additional supply of domestic water from the watershed of the Connecticut River and, with the aid of lantern slides, described the more interesting features of the Ware and Swift River developments. After discussions of the subject had been given by R. W. Armstrong, R. H. Keays, T. Kennard Thomson, and Robert Ridgway, the meeting adjourned and refreshments were served.

New Mexico Section

The New Mexico Section of the Society held its annual meeting at the Airport Tavern, near Albuquerque, on December 13. Included in the business session was the election of officers for 1934, which resulted as follows: H. C. Neuffer, President; W. C. Davidson, First Vice-President; Berkeley Johnson, Second Vice-President; and H. L. Thompson, Secretary-Treasurer.

Northeastern Section

At the annual meeting of the Northeastern Section, held in Boston on January 27, the following were elected to serve as officers for the coming year: Harrison P. Eddy, Jr., President; F. N. Weaver, Vice-President; and Harry P. Burden, Secretary-Treasurer.

Oklahoma Section

The Oklahoma Section held its annual meeting at Oklahoma City on December 22, 1933, and elected A. R. Losh, President, and Frank Herrmann, Secretary of the Section for the forthcoming year.

Philadelphia Section

At a meeting of the Philadelphia Section, held on January 17, illustrated addresses on the subject of underpinning were presented by Edward P. Albright, an engineer with the Underpinning and Foundation Company, Inc., of New York, N.Y., and Charles B. Spencer, vice-president of Spencer, White and Prentis, Inc., also of New York. The meeting was attended by 105 members and guests, and there were 46 at the dinner preceding the meeting.

Portland (Ore.) Section

There were 36 members and guests present at a luncheon meeting of the Portland (Ore.) Section held on December 7, 1933. The speaker of the occasion was Col. J. P. Hogan, consulting engineer of New York, N.Y., who spoke on the subject of possible markets for Columbia River power. On January 5, 1934, the Section held its annual meeting. Included in the business session was the election of officers for 1934, which resulted as follows: Carl F. Thomas, President; J. H. Polhemus, Second Vice-President; and Geary Kimbrell, Treasurer. Other officers elected in 1933, whose terms will continue through 1934, are Lyman Griswold, Vice-President, and G. H. Canfield, Secretary. The guest speaker was the Rev. Nathan B. Ackerman, who spoke on the subject, "The Coming Struggle for Power." Before the meeting adjourned the newly elected president, Mr. Thomas, gave a brief talk.

Rochester Section

At a meeting held on January 4, the Rochester Section elected officers for 1934 as follows: Carl C. Cooman, President, and William H. Roberts, Secretary.

Sacramento Section

Recent meetings of the Sacramento Section of the Society have been addressed on a variety of interesting and timely subjects. Included among the speakers were Harry N. Jenks, consulting sanitary engineer, of Berkeley, Calif.; Raymond Matthew, Hydraulic Engineer, State (California) Division of Water Resources; T. E. Stanton, Jr., Materials and Research Engineer, State (California) Department of Public Works; and Charles S. Pope, Chief Construction Engineer, California Division of Highways. At the annual meeting held on January 9, Harlowe M. Stafford was elected president of the Section for 1934, and Frank D. Talbot, secretary.

San Diego Section

The January meeting of the San Diego Section was held on the 25th at the Churchill Hotel. A talk on the subject, "Consideration of Yachts and Motor Boats as Commerce," was given by Capt. Ivan B. Snell, who outlined the national movement to gain Federal recognition of such craft as commerce.

San Francisco Section

There were 85 members and guests present at a meeting of the San Francisco Section held at the Engineers Club on December 19, 1933. Included in the business session was the reading of short committee reports of the year's activities The feature of the occasion was a talk by Charles Derleth, Jr., dean of the College of Engineering of the University of California. His subject was "Metropolitan Changes to Result from the San Francisco Bay Bridges."

Seattle Section

On January 22, the Seattle Section elected officers for 1934 as follows: Luther E. Gregory, President; R. M. Murray, Vice-President; and Miles E. Clark, Secretary.

Spokane Section

A luncheon meeting of the Spokane Section was held at the Davenport Hotel in Spokane on January 12. Election of officers for 1934, which took place at that time, resulted as follows: E. H. Collins, President; B. J. Garnett, First Vice-President; T. H. Judd, Second Vice-President; and Philip G. Holgren, Secretary-Treasurer. A report of the local activities of the CWA on its U. S. Coast and Geodetic Survey projects was given by A. J. Turner, construction superintendent for the Phoenix Utility Company, of Spokane. This report revealed the encouraging fact that very few engineers in need of CWA work have been found in the vicinity of Spokane.

Tacoma Section

At the December 11th meeting of the Tacoma Section officers for 1934 were elected as follows: W. A. Kunigk, President, and O. H. Hallberg, Secretary-Treasurer. Following the business meeting, Kenneth A. Kobe, of the University of Washington, gave an interesting talk on the work of the chemical engineering department of the University.

Toledo Section

On December 19, 1933, the Toledo Section held its annual meeting and elected the following officers for 1934: George Champe, President, and Porter W. McDonnell, Secretary.

Virginia Section

The Virginia Section announces that its officers for 1934 will be the following: J. E. Crawford, President, and P. A. Rice, Secretary.

Student Chapter News

Lewis Institute

The Lewis Institute Student Chapter has recently held several interesting meetings. On one occasion it cooperated with the local student branch of the American Society of Mechanical Engineers in presenting a program that featured L. D. Gayton, Assistant Engineer of the City of Chicago, as the speaker. The attendance was 162. The Chapter has also made an inspection trip through the Chicago Avenue Water Tunnel, which proved very instructive.

Rhode Island State College

On January 14 the Rhode Island State College Student Chapter held its fourth meeting of the semester, which was attended by 43 students and 7 faculty members. The principal speaker was Prof. S. H. Webster, of the college, who gave an illustrated lecture on the subject, "The Lewis and Clark Expedition."

ITEMS OF INTEREST

Engineering Ideas and Events in Brief

CIVIL ENGINEERING for April

BECAUSE of the severe illness of the author, the article, "Details of Steel Sheet Piling Bulkheads," by R. P. Pennoyer, Assoc. M. Am. Soc. C.E., failed to appear in the February number as announced. It is now scheduled for April. Another article which could not appear as originally scheduled is that by Captain A. W. Stevens, U.S. Army pilot and aerial photographer, based on his address at the Annual Meeting of the Society. This is still in preparation, but it is hoped that it also may be available for April.

Judged on the basis of its cost, its length over navigable water, and the depth of many of its piers, the San Francisco–Oakland Bay Bridge is probably the largest bridge enterprise ever undertaken, although both its suspension and its cantilever spans are shorter than other existing spans. Its chief engineer, C. H. Purcell, Assoc. M. Am. Soc. C.E., has prepared a brief yet comprehensive article which gives an excellent conception of many phases of this record-breaking project.

Another article planned for the April number is by R. D. Goodrich, M. Am. Soc. C.E. According to a usual method of irrigation in the West, the irrigator, from experience with his particular soil, releases water from a ditch in sufficient quantity to reach the lower edge of a strip of land before that at the upper part penetrates below the root level. Engineers have made various attempts to reduce the factors involved to a formula. Based on some experimental work of his own, Mr. Goodrich presents a rational formula which gives the relationship between the quantity of water released, the area to be covered, and the time required to cover it.

In an article by Donald Barnes, Jun. Am. Soc. C.E., a 1933 Freeman Traveling Scholar, some of the interesting work done at the National Hydrotechnic Institute of Czechoslovakia is to be presented. Many problems of power, navigation, flood control, and irrigation are being studied with models at this laboratory, established soon after the formation of the republic in 1918. Among these, the most spectacular was the test made to control the design of the spillway and stilling basin for the Vranov Dam, the first concrete dam to be built in the country. It is an arched gravity structure having a height of 180 ft and a crest length of 960 ft.

Simplified solutions of some problems involving the tractive effort of locomotives and the resistance of trains are given in the article by A. C. Barrow, Assoc. M. Am. Soc. C.E. This subject is one that has intrigued railroad engineers for years, and many formulas and methods have been presented to find the speed attainable by a given locomotive on a known grade and the time required to attain it.

The Advancement of the Engineering Profession

Excerpts from an Address at the Hall of Science (Chicago) During Engineers' Week, June 1933

By J. A. L. WADDELL, M. AM. SOC. C.E.

CONSULTING ENGINEER, NEW YORK, N.Y.

WHEN I graduated from college in 1875, engineering was more or less of a trade—possibly in some respects an art, but certainly not a science. Designing and construction had been done mainly by cut-and-try methods, or rule of thumb. A few outstanding engineers had been working hard to raise their calling to a higher plane, and with a certain amount of success. They had to struggle against the almost universally prevalent notion that the practical man in engineering was superior to the theoretical man, as they dubbed anyone who had graduated from a technical school. In fact, a graduate engineer was at a distinct disadvantage in those days. It took a decade or two to correct that false impression; but certainly the correction was done effectively, because nowadays, in order that a young man may secure engineering work of any importance, he must be a graduate of a technical school of good standing.

The last half century has seen some wonderful developments in the betterment of the conditions affecting human life—and most of these are due to the work of the engineer. This fact is so universally acknowledged that it is not necessary to defend the statement.

Within my own lifetime there have been inaugurated and developed the electric light, the electric railway, and all the other accomplishments of electrical engineering, the telephone, wireless telegraphy, the radio, the automobile, the submarine, the flying machine, the typewriter, the vertical lift bridge, reinforced concrete construction, and practically all the important accomplishments of chemical engineering. All these fundamental developments are due to the work of the engineer, which work includes also the elaboration and perfection of many of the long-established types of construction in civil, mechanical, and mining engineering.

In view of all these important discoveries, developments, and accomplishments, what right have we to be dissatisfied with the advancement the engineering profession has made and is still making? I shall tell you. There is no valid fault to be found concerning its advancement as either an art or a science—far from it! But it has been woefully lacking in advancement as a profession. Who is to blame for this? There is only one possible answer to that question—ourselves. And until engineers as a body decide to work together on ethical, civic, business, and economic interests, the evil will continue to exist. Cooperation is the secret of professional success, and this principle not only must be universally acknowledged but also must be acted upon.

One of the most effective means for advancement is research; and in this, I am happy to say that, although our profession has been weighed in the balance, it has not been found wanting. All important developments in engineering are fundamentally based on research, be it scientific, mathematical, chemical, mechanical, electrical, or any other kind, not excepting financial and psychological. This is because all functions of materials, forces, and men are, or may be, factors in the proper design, construction, and operation that result from true engineering. Obviously, therefore, the engineering profession, even more than any other, must constantly create or acquire increasing amounts of able and often elaborate research on a wide range of subjects.

Research has cut production costs, retained consumer good will, and developed a host of new products during the depression. Most assuredly, research work of the proper kind is one of the most important means for the advancement of the engineering profession.

If there were effected today a marked improvement in the quantity and quality of new technical literature, the engineering profession would be decidedly benefited. When I compare the technical books of the present time with those of my student days and those of my early engineering career, I feel so overwhelmed by the immense differences as to deem myself hardly justified in making any adverse comments; nevertheless, I recognize the irrefutable fact that a large number of the practitioners who have arrived at the top have failed to tell their brother engineers all the things that they alone know about their specialties. For my part, I have long maintained that it is utterly inexcusable for any engineer to die possessed of valuable knowledge which no one else shares.

Only a small minority of engineers read enough technical literature. The excuse for an engineer's not buying books, if his office is located in a large city, is that he can always go to the technical library and either read there or borrow the books he needs. But he does not go, for either he is too busy, or the day is too hot or too cold, or he can just as well go another time. Every live engineer who desires to succeed in his profession should own and keep at hand a fairly large, but quite select, library, composed of the books he is most likely to require for doing his daily work.

Too many designers are content to follow old, established practice; but if the profession is really to advance, we must be continually evolving new methods based strictly on economic principles. There is a dearth of literature on engineering economics; and this condition tends to force designers to determine economic principles for their own work.

Much yet remains to be done in order to increase to the limit of effectiveness the various methods of technical instruction. In the first place, the length of the regular engineering course has to be increased from four to five years; many broadening subjects must be added; the morale of students must be raised; and their interest in their work must be excited and maintained. I have long claimed that it is a serious mistake to crowd into the first two years of the course a lot of preparatory studies which are really not engineering subjects (although, of course, strictly essential), to the exclusion of many simple technical subjects in which practical-minded students would be much interested. Such exclusion causes many of the young men to lose interest in their studies and even to quit the course and take up some other line than technics for their life's work.

A thorough command of his own language is of more importance to any engineer who occupies a high position than is even his knowledge of mathematics. He can hire somebody to do his computing for him—but not to do his talking. The English of many engineers in America is sometimes crude; and until this fault is corrected, our profession will not occupy the high place in society that its importance warrants.

Even though the engineering courses of today be lengthened to five years, any one who desires to possess special knowledge in any particular line will have to do some postgraduate studying, extending generally over two years, and sometimes even longer. The amount of knowledge that an engineer must possess, in order to be successful these days, is simply overwhelming.

It is conceded today that the engineer must take his proper place in society as a leader and manager rather than as merely a follower of the lawyer, the business man, and the politician; and, when he does so, an important step in the advancement of the engineering profession will have been taken.

NEWS OF ENGINEERS

From Correspondence and Society Files

J. C. Oblan is now Technical Director for the Gipronimstalmost (State Institute of Design and Scientific Research), with headquarters in Moscow, U.S.S.R.

Ralph W. Hawks is now employed as an engineer in the Orange County (New York) Highway Department, with headquarters in Middletown, N.Y.

Ethan F. Ball has been promoted from the position of engineer with the McClintic-Marshall Corporation, of Bethlehem, Pa., to that of Assistant Chief Engineer in the same organization.

Gilbert B. Grunwell has been promoted from the position of rodman with the U. S. Geological Survey to that of a junior engineer in the same organization. His headquarters are still Punta Gorda, Fla.

A. Mitchell has recently accepted a connection in the Bridge Department of the North Carolina State Highway and Public Works Commission. His office is in Raleigh, N.C.

Edward R. Neff has resigned as city engineer of Miami Beach, Fla., to accept the position of project engineer in the Florida State Road Department, with headquarters in Jacksonville, Fla.

Charles W. Allen is now in the State Highway Testing Laboratory of the Engineering Experiment Station of Ohio State University, in Columbus, Ohio.

Harold W. Baker, who was formerly director of construction for the Government of the District of Columbia, has become city manager of Rochester, N.Y.

Thomas G. McCrory has resigned as chief engineer of the Washington Department of Highways to accept an engineering connection with the State of Washington Canal Commission. His headquarters are Olympia, Wash.

Merle Parvis is now an assistant project engineer with the Indiana State Highway Commission. His office is in Bowling Green, Ind.

Milo S. Ketchum because of protracted illness has asked to be relieved from the arduous administrative duties of dean of the College of Engineering and director of the Engineering Experiment Station of the University of Illinois. He has accepted appointment as Research Professor of Civil Engineering.

J. Roy McAuliffe has accepted a position as assistant superintendent of construction with the United Engineers and Constructors, of Philadelphia, Pa. He was formerly connected with Dwight P. Robinson and Company, Inc., of Long Beach, Calif.

H. W. Knox has resigned his position with the E. O. Roberts Company, Inc., of New York, N.Y., to become resident engineer for Parsons, Klapp, Brinckerhoff and Douglas, of the same city.

Edmund Wilkes, Jr., formerly chief structural engineer for the Jones-Hettelsater Construction Company, of Kansas City, Mo., has recently established a consulting engineering practice in the same city. He will specialize in structural design.

Edwin C. Eckel, mining geologist of Washington, D.C., has accepted a position as geologist for the Tennessee Valley Authority, with headquarters in Knoxville, Tenn.

Burr H. Simpson has resigned as city engineer of Buckhannon, W. Va., to become district engineer for the West Virginia State Road Commission. His headquarters are Keyser, W.Va.

Ernst Maag, of Pasadena, Calif., is now with the Los Angeles County Regional Planning Commission.

M. J. Bussard has recently accepted a position as resident engineer on sewer construction in the Sanitary Department of the District of Columbia.

Norman M. Smith has been promoted from the rank of Commander to that of Rear Admiral, C.E.C., U.S.N. He has been transferred from the Navy Yard at Boston, Mass., to the Bureau of Yards and Docks, Washington, D.C.

Douglas H. Burnett has severed his connection as sanitary engineer for the Oregon-Washington Water Service Company, of Salem, Ore., to join the general engineering staff of the Standard Oil Company, of California, with headquarters in San Francisco, Calif.

Laurence B. Manley, who was formerly principal assistant engineer in the Department of City Transit, of Philadelphia, Pa., is now office engineer for the Delaware River Joint Commission of Pennsylvania and New Jersey, with offices in Camden, N.J.

William J. Howard and Edward J. Hughes, of Chicago, have taken over the business and equipment of the Kelly-Atkinson Construction Company, steel erectors, and formed a firm to be known as the Northern Bridge Company.

Ronald D. Ward is now in the operating department of the Shell Petroleum Corporation of St. Louis, Mo. Previously he was an assistant engineer in the bridge department of the Wabash Railway.

T. Shiraishi, lecturer at the Imperial University of Tokyo (Japan), has been made president of the Shiraishi Foundation Company, of Tokyo.

C. Frank Class, Jr., has taken a position as structural engineer with C. Frank Class, of Harrisburg, Pa.

Ernest B. Yeatts, formerly a draftsman with the West Texas Utilities Company, of Abilene, Tex., is now employed as resident engineer by the Texas State Highway Department, with headquarters at Haskell, Tex.

S. K. Young has been made chief statistician for Hemphill, Noyes and Company, of New York, N.Y.

L. M. Pharis has resigned as chief engineer of the Minnesota Power and Light Company, of Duluth, Minn., to accept a position in Shanghai, China, with the Shanghai Power Company.

Changes in Membership Grades

Additions, Transfers, Reinstatements, Deaths, and Resignations

From January 10 to February 9, 1934, Inclusive

Additions to Membership

Atkin, Morris (Jun. '33), 1410 St. George Ave., Linden, N.J.

Beavin, Benjamin Everett (Assoc. M. '34), Asst. Chf. Engr., Annapolis Met. Sewerage Comm. (Res., 239 Prince George St.), Annapolis, Md.

Behrens, Joe Charles (Jun. '33), 4300 Maypole Ave., Chicago, Ill.

Bhatt, Upendra Jivahram (Jun. '33), Care, M. Pandya, Takhteshwer, Bhavnagar, India.

Brinker, Louis Edwin (Jun. '33), 1657 West 70th St., Los Angeles, Calif.

Burkhardt, Scott (Jun. '33), 1191 South Corona, Denver, Colo.

Calhoun, Frank Elbert (Jun. '33), 1709 East Strong St., Pensacola, Fla.

Castellan, Norman John (Jun. '33), 1926 Walnut St., Boulder, Colo.

Clingerman, John Wakefield (Jun. '34), 409 Arthur Ave., Scottsdale, Pa.

Cutchin, Braxton Murray, Jr., (Jun. '33), Warren Green Hotel, Warrenton, Va.

Daudt, Carl Fabian (Jun. '33), 5600 Colorado Ave., N.W., Washington, D.C.

Elliott, Arthur Leonard (Jun. '33), 3214 North East 59th Ave., Portland, Ore.

Erickson, Harry Wilbert (Jun. '33), 212 North 41st St., Seattle, Wash.

Fargher, Thomas Edwin Nelson (Assoc. M. '33), Head, Dept. of Mech. and Civ. Eng., Loughborough Coll. (Res., 139 Ashby Rd.), Loughborough, Leicestershire, England.

Fink, Herbert Henry (Jun. '33), 895 Princeton St., Akron, Ohio.

Geyer, George (Assoc. M. '34), 51 West 87th St., New York, N.Y.

Gonzalez, Manuel Francis (Jun. '33), Box 4026, Station F, New Orleans, La.

Goss, Louis Harold (Jun. '33), 4350 Gleason St., Los Angeles, Calif.

Greene, Robert (Jun. '34), Eng. Asst., Bureau of Design, Borough Pres. of the Bronx (Res., 2104 Bronx Park East), New York, N.Y.

Gregory, Thomas McFarland (Jun. '33), 4416 Edmondson Ave., Dallas, Tex.

Hall, Norman Henry (Jun. '33), 1842 Capitol Ave., Des Moines, Iowa.

Hill, Archie Kerr (Jun. '33), Hyrum, Utah.

Idema, Jacob (Jun. '33), 1821 Fifth Ave., Troy, N.Y.

Ketchum, Smith Adron (Jun. '33), With U. S. Bureau of Reclamation, 1361 Logan, Denver, Colo.

Kinsella, John Richard (Jun. '34), (Thiel & Kinsella); City Engr., South Gate, Ind. (Res., 935 Hamlet St., Newport, Ky.)

Larkin, Kenneth Hoyt (Jun. '33), 6701 East 18th St., Kansas City, Mo.

Larrowe, Albertus Eugene (Jun. '33), 2748 North East Tillamook St., Portland, Ore.

Lynch, Leonard Thomas (Jun. '33), 517 South Main St., Old Forge, Pa.

Lynge, Raymond Thomas (Jun. '33), Camp 66, P.E., Murphrysboro, Ill.

Macdonald, Robert George (Jun. '33), Care, U. S. Geological Survey, Scovern Hot Springs, Bodfish, Calif.

McGowan, Thomas Francis (Jun. '33), 378 Park St., San Francisco, Calif.

Male, Seymour (Jun. '33), 210 Riverside Drive, New York, N.Y.

Meadowcroft, Niel Fairhurst (Jun. '33), Office Engr., Bridge Dept., Eng. Dept., U.S. Forest Service, San Francisco (Res., 115 Cornelia Ave., Mill Valley), Calif.

Neel, Charles Herbert (Jun. '33), Junior Engr., Bureau of Reclamation (Res., 2236 High St.), Denver, Colo.

Ogle, William Warren (Jun. '33), 9 Locust St., Greenwich, Conn.

Parks, Rector (Jun. '33), Pleasant Lake, Ind.

Phelan, Paul Frederick (Jun. '34), 519 Avery St., N.S., Pittsburgh, Pa.

Price, Robert Luman (Jun. '33), 627 Greenwood Ave., Toledo, Ohio.

Swift, William Patrick (Jun. '33), 216 East Tremont Ave., New York, N.Y.

Tatlow, Richard Henry, III, (Assoc. M. '34), Asst. to Administrative Asst. to Administrator of Federal Emergency Administration of Public Works (Res., 2530 Q St., N.W., Apartment 32), Washington, D.C.

Uhrich, Morris Bordner (Jun. '33), Care, U. S. Eng. Dept., Montpelier, Vt.

Winschuh, Albert Joseph (Jun. '33), 205 Lincoln Ave., Totowa, N.J.

Wyman, Jack A. (Jun. '33), 3416 California St., Omaha, Nebr.

Membership Transfers

Brackett, Woodbury Edmund (Jun. '31; Assoc. M. '34), Town Mgr., Washburn, Me.

Carpenter, Lewis Van (Assoc. M. '26; M. '34), Head, Dept. of Civ. Eng., Univ. of West Virginia, Box 562, Morgantown, W.Va.

Caspar, Ferdinand Edward (Jun. '32; Assoc. M. '34), Asst. Engr., City of Orange (Res., 227 Henry St.), Orange, N.J.

Coltharp, John Robert (Jun. '31; Assoc. M. '34), Chf. Engr., Southwestern Aerial Surveys, Inc., 108 East 10th St. (Res., 401 East 31st St.), Austin, Tex.

Crosby, Hewitt (Assoc. M. '09; M. '34), Gen. Mgr. and Chf. Engr., Long Island Shipyard, Inc. (Res., 117 Tuthill St.), Port Jefferson, N.Y.

Duncan, Daniel Tompkins (Assoc. M. '30; M. '34), Civ. Engr., Room 401, Professional Bldg., Greenwood, S.C.

Gorman, Sidney Silvey (Jun. '21; Assoc. M. '25; M. '33), Senior Bridge Designing Engr., State of California (Res., 778 Faxon Ave.), San Francisco, Calif.

Hammell, Charles Edward (Assoc. M. '25; M. '34), Senior Engr., U. S. Engr. Office, 413 Custom House, Cincinnati, Ohio.

Hicks, Stuart Fenn (Jun. '27; Assoc. M. '34), Senior Bridge Project Engr., State Highway Dept. (Res., 1009 Fourth St.), Three Rivers, Mich.

Holdefer, Joseph Lutz (Jun. '27; Assoc. M. '34), With State Highway Comm. (Res., 412 Twenty-Sixth St.), Sioux City, Iowa.

Howe, Jerome Willard (Assoc. M. '24; M. '34), Prof. and Head of Dept. of Civ. Eng., Worcester Polytechnic Inst. (Res., 3 Laconia Rd.), Worcester, Mass.

Krefeld, William John (Jun. '15; Assoc. M. '21; M. '34), Asst. Prof., Civ. Eng., Columbia Univ. (Res., 464 Riverside Drive), New York, N.Y.

Lyse, Inge Martin (Assoc. M. '28; M. '34), Research Associate Prof. of Eng. Materials, in charge, Fritz Eng. Laboratory, Lehigh Univ., Bethlehem, Pa.

Mackenzie, Ray Elliott (Jun. '22; Assoc. M. '30; M. '34), Engr., U. S. Engr. Dept., U. S Engr. Office, Custom House, Portland, Ore.

Olewiler, William Norman (Jun. '24; Assoc. M. '33), Orchard Drive, Ossining, N.Y.

Perez, Santiago Victor (Jun. '24; Assoc. M. '34), Chf. Engr., Bureau of Public Works, Province of Pinar del Rio, 110 Lealtad St., Havana, Cuba.

Russell, Lewis Walter (Assoc. M. '27; M. '34), Supt., Bates & Rogers Constr. Co., Vestal, N.Y.

Salage, David (Jun. '29; Assoc. M. '33), Asst. Engr., Grade 4, Dept. of Water Supply, New York (Res., 52–15 Bowne St., Flushing), N.Y.

Smith, Schuyler Morton (Assoc. M. '16; M. '34), Bridge Engr., St. Louis County Highway Dept.; 7624 Carrswold Drive, Clayton, Mo.

Taylor, Nelson (Jun. '11; Assoc. M. '13; M. '33), Cons. Engr. (Salisbury, Bradshaw & Taylor), 743 Petroleum Securities Bldg., Los Angeles, Calif.

Wilkin, Increase Crosby Jordan (Jun. '24; Assoc. M. '33), Land Surv., Gardiner, N.Y.

Reinstatements

Caldwell, William Metz, Jun., reinstated Feb. 2, 1934.

Kemmler, Edward Albert, M., reinstated Jan. 29, 1934.

Sylvester, Harold MacTavish, Jun., reinstated Jan. 11, 1934.

Resignations

Boyer, Lee Calvin, Jun., resigned Jan. 29, 1934.

Brueckmann, Frank George, Assoc. M., resigned Jan. 29, 1934.

Cameron, Harry Frank, M., resigned Jan. 16, 1934.

Chandler, James Frederick, Jun., resigned Jan. 30, 1934.

Cooke, Philip Charles, Jun., resigned Jan. 16, 1934.

Daybill, Alfred, Affiliate, resigned Jan. 29, 1934.

Deklotz, Leonard Anthony, Jun., resigned Jan. 30, 1934.

Duffy, Leo John, M., resigned Feb. 1, 1934.

Fitzgerald, Edmund Landers, Jun., resigned Jan. 9, 1934.

Forte, Matthew George, Jun., resigned Jan. 9, 1934.

Garfias, Valentine Richard, M., resigned Jan. 16, 1934.

Guild, Wilbur Gillfillan, Assoc. M., resigned Jan. 9, 1934.

Hande, John Hallward, Assoc. M., resigned Jan. 12, 1934.

Hoffman, James Francis, Jun., resigned Jan. 26, 1934.

Horschel, Harold Frederick, Jun., resigned Jan. 26, 1934.

Kanegsberg, Richard, Jun., resigned Jan. 10, 1934.

Kingsland, Lawrence Douglas, 2d, Assoc. M., resigned Feb. 2, 1934.

Metcalfe, Henry Moore, Jun., resigned Jan. 9, 1934.

Moore, Donald Edwin, Jun., resigned Jan. 16, 1934.

Newcomer, Albert Waldo, Assoc. M., resigned Jan. 26, 1934.

Prezioso, George Silvio, Jun., resigned Jan. 9, 1934.

TOTAL MEMBERSHIP AS OF FEBRUARY 9, 1934

Members	5,752
Associate Members	6,256
Corporate Members	12,008
Honorary Members	18
Juniors	3,079
Affiliates	108
Fellows	5
Total	15,218

Prokes, Charles Albert, Assoc. M., resigned Jan. 12, 1934.

Ridley, Clarence Eugene, Assoc. M., resigned Feb. 1, 1934.

Roberts, Alfred Vaile, Assoc. M., resigned Jan. 30, 1934.

Sargent, Charles Daniel, M., resigned Feb. 5, 1934.

Schreiber, Hermann Victor, M., resigned Jan. 11, 1934.

Stephens, Governeur Robert, Assoc. M., resigned Jan. 16, 1934.

Ward, Vernon Champlin, M., resigned Jan. 29, 1934.

Williams, Maurice William, M., resigned Feb. 1, 1934.

DEATHS

Chapman, James Russell. Elected M., March 6, 1901; died Jan. 11, 1934.

Christian, William Arnold. Elected M., Oct. 3, 1911; died Feb. 4, 1934.

Donaghey, John Thomas. Elected M., Nov. 15, 1926; died Nov. 30, 1933.

Goodridge, John Wesley. Elected Jun., Oct. 4, 1898; Assoc. M., April 5, 1905; died Feb. 4, 1934.

Hord, Frank Firth. Elected Jun., April 15, 1929; died Jan. 5, 1934.

Kelly, Earl Wallace. Elected Assoc. M., Aug. 31, 1915; M., Nov. 26, 1923; died Jan. 30, 1934.

Paterson, Herbert. Elected Assoc. M., Aug. 31, 1925; date of death unknown.

Rush, Paul Van. Elected Jun., Feb. 10, 1930; died March 13, 1933.

Stenstrom, Gustaf Alexander. Elected Assoc. M., Dec. 22, 1930; died Jan. 26, 1934.

Taylor, Milo Cornelius. Elected M., April 23, 1928; died Sept. 4, 1933.

Vars, Alexander Wilson. Elected M., Oct. 15, 1923; died Jan. 14, 1934.

Wasson, Joseph Houston. Elected Assoc. M., April 3, 1922; M., Jan. 16, 1928; died Jan. 7, 1934.

Men Available

These items are from information furnished by the Engineering Societies Employment Service, with offices in Chicago, New York, and San Francisco. The Service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 97 of the 1933 Year Book of the Society. To expedite publication, notices should be sent direct to the Employment Service, 31 West 39th Street, New York, N.Y. Employers should address replies to the key number, care of the New York office, unless the word Chicago or San Francisco follows the key number, when the reply should be sent to the office designated.

CONSTRUCTION

Civil Engineer; Assoc. M. Am. Soc. C.E.; 36; bachelor, master's, and professional degrees, Purdue University. Experienced on concrete girder, arch, and steel bridges as: inspector, field and office engineer, draftsman, designer, field superintendent of erection, designer and detailer of concrete forms in panels, cofferdams, arch centering, falsework, erection equipment. D-864.

Resident Engineer; M. Am. Soc. C.E.; married; 30 years experience, in responsible charge of field work on construction of all kinds of railroad and highway bridges, culverts, etc., including some of the larger railroad and highway bridges. Available immediately. Prefer to be east of the Mississippi River and north of Charleston, S.C. D-2697.

Civil Engineer; Assoc. M. Am. Soc. C.E.; 37; 17 years experience, railroad and highway location, plans and construction; contour mapping; quarrying and crushing superintendent and general engineering at cement plant. Prefers location in South but would consider any location. C-1887.

DESIGN

Civil and Structural Engineer; Jun. Am. Soc. C.E.; 30; B.S. in C.E. and C.E. degrees; about 5 years experience in New York City as a designer, detailer, draftsman, checker, and estimator of steel and reinforced concrete. References and samples of work sent on request. C-6186.

Structural Engineer; Jun. Am. Soc. C.E.; 27; B.S. (C.E.); married; one child; 6 years experience—mainly in steel and concrete design, steel detailing and checking, miscellaneous work in surveying and machine design; location anywhere in the United States; prefers job as chief draftsman with small steel company; reasonable salary. Available two weeks notice. D-2452.

Civil Engineer; Assoc. M. Am. Soc. C.E.; 30; single; graduate; licensed; 12 years experience in structural design, drafting, and surveying. Design of steel and concrete railroad tunnel structures; indeterminate analysis; alignments; checker on construction drawings; 7 years charge of work; 2 years park and highway surveying. Can translate technical German. D-2630.

Civil Engineer; Assoc. M. Am. Soc. C.E.; 32; married; New Jersey structural license; B.S. in C.E.; 12$^1/_2$ years structural experience, designing and detailing concrete and steel railroad and highway bridges; flat-slab, steel, and timber industrial buildings, and reinforced concrete dams. Desires field or office position. Location immaterial. D-1976.

Graduate Civil Engineer; Jun. Am. Soc. C.E.; 26; 4$^1/_2$ years experience in design, specifications, drafting, construction, and surveying. Design, detail, preparation of plans and specifications, and supervision of municipal improvements, highways, and concrete structures; excellent draftsman. Salary secondary to opportunity to demonstrate worth to employer. Location immaterial. D-2559.

Civil Engineer; Assoc. M. Am. Soc. C.E.; graduate C.E.; 33; married; 10 years experience, design of reinforced-concrete and structural steel bridges, steel plants, blast furnace, skip bridges, indeterminate structures, heavy foundations. Writes and speaks German and French perfectly. Suitable man for foreign work. Available at once. Location and salary secondary. First class references. D-2019.

Civil Engineer; Jun. Am. Soc. C.E.; 32; married; B.S. in C.E.; 7 years in architect's office as draftsman; 3 years in structural engineer's office on responsible design of steel framing, reinforced-concrete foundations, retaining walls, slabs, etc. Desires field or office position. Available immediately. D-2037.

Civil Engineer; Jun. Am. Soc. C.E.; 28; married; civil engineer's degree, Polytechnic Institute of Brooklyn; special course in structural engineering; 9$^1/_2$ years practical experience, structural steel design for subways, piers, pier sheds, tunnels, buildings in railroad yards, and elevated structures. Checker of shop drawings; excellent draftsman. Available immediately. Location anywhere. D-1754.

Bridge and Structural Engineer; M. Am. Soc. C.E.; 41; married; B.S. and M.S.; 17 years experience in designing and directing design work on highway and railroad bridges of all types in steel, stone, and concrete, and on other structures; 2 years teaching bridge engineering and theory of structures. Available immediately. D-1695.

Civil Engineer; Assoc. M. Am. Soc. C.E.; B.S. in C.E.; 30; single; 8 years experience in the design of railroad and highway bridges. Desires position with an engineering organization or is willing to make start in a field allied to engineering. Location immaterial. Available immediately. D-1554.

EXECUTIVE

Civil Engineer; Assoc. M. Am. Soc. C.E.; graduate of Lafayette College; licensed civil engineer and land surveyor, New Jersey; 44; married. Ability to render important engineering decisions in design and construction. Design of structural steel, reinforced concrete. Experience in railroad work, subway, power plant, and valuation work. B-3292.

Graduate C.E.; Assoc. M. Am. Soc. C.E.; M.E.; native born; married; 38; 17 years with last employer in responsible capacities, pulp, paper, hydro-electric plant design, and construction. Wants job in brewing or other industry requiring vigorous personal application and high sense of responsibility. Location anywhere. Salary moderate, provided future opportunity is bright. Available now. D-1915.

Structural Engineer; Assoc. M. Am. Soc. C.E.; 33; married; New York State license; 15 years field and office; experienced in design of office and industrial buildings and flat-slab factory buildings. Municipal experience in bridges, water works, paving, and building inspection. Had responsible charge of writing contracts and specifications, also supervision of appraisals. Location immaterial. D-1729.

Civil Engineer; Assoc. M. Am. Soc. C.E.; 37; married; registration in Pennsylvania; broad experience in plant layout, structural design, contract plans and specifications, estimating, and construction. Familiar with water works, sewage disposal, steam power plants, foundations, bridges, viaducts, and general building work. Available at once for responsible charge, or research work. Location Pittsburgh. D-1525.

Civil Engineer; M. Am. Soc. C.E.; graduate, Michigan State College and Cornell University; 30 years experience on structural steel work, as chief engineer, general superintendent, plant manager; thoroughly experienced in all departments, office, shop, erection, excepting sales; had full charge of plant comprising iron foundry, machine, structural, ornamental, concrete bar, and tank shops. D-2805.

Executive Engineer-Sales; M. Am. Soc. C.E.; 46; married. Over 20 years broad experience in engineering and sales of steel fabricating business—active and supervising capacity—also as district representative for leading concern in western Pennsylvania and Ohio. Well acquainted with the trade. Will welcome opportunity to correspond in detail. C-5095.

JUNIOR

Civil Engineer; Jun. Am. Soc. C.E.; B.S. in C.E., Lafayette College, 1931; experienced in sales work; has been supervisor in receiving department of large department store. Desires work in teaching or any branch of civil engineering. Excellent references. Available immediately. Location immaterial. D-2578.

Junior Engineer; Jun. Am. Soc. C.E.; 25; B.S. in C.E., 1929. Desires any type of engineering, teaching, or construction position. Has had 2$^1/_2$ years experience as private tutor, junior metallurgist, and special mill-building lay-out man in steel mill. D-1911.

Civil Engineer; Student Member; 23; single; B.S. in C.E., Yale School of Engineering, 1933; 2 courses in advanced stresses; 3 in surveying; 3 summers experience as estimator, foreman, timekeeper for contracting corporation on excavation and road construction work. Desires work, any branch civil engineering, anywhere. D-2670.

Civil Engineer; Jun. Am. Soc. C.E.; 25; single; B.E., Johns Hopkins University; A.B., Western Maryland College; 2 years experience in highway inspection. Interested in research, reports, cost studies, chart building, teaching, design, and construction. Desires permanent position with consulting or contracting firm. Location immaterial. D-2777.

Civil Engineer; Jun. Am. Soc. C.E.; Rensselaer Polytechnic Institute, 1931; 27; single; $2\frac{1}{4}$ years experience on construction and estimating concrete; field experience in surveying. Desires position in field or office in any branch of civil engineering. Location immaterial. Available immediately. D-2787.

Jun. Am. Soc. C.E.; B.S. in C.E., 1932; part of work for master's degree completed; 3 years experience—2 in business office, clerical and analytical work, at which still employed. Desires employment in a business position where technical training is of value. Interested in cost accounting, management, business economics. D-2796.

Civil and Structural Engineer; Jun. Am. Soc. C.E.; 29; single; B.S. in C.E.; 4 years experience with large eastern steel company, detailing, checking, layout work in engineering department; 1 year, field and office with land surveyor; 2 years design work, steel and concrete highway bridges and viaducts. Prefers position with consulting engineer or architect. D-2503.

Civil Engineer; Jun. Am. Soc. C.E.; 24; single; graduate of Ohio Northern University, B.S. in C.E. Experience in general engineering practice, especially surveying, with some topographic and construction work. Salary no object other than to make a living. Available immediately. Location immaterial. D-2177.

Civil and Structural Engineer; Jun. Am. Soc. C.E.; 25; single; B.S. in C.E., Kansas State College; M.S. in C.E., West Virginia University. Experienced in drafting; inspection of highway construction; bridge and concrete design; construction surveys. Desires connection with older consulting engineer. D-2804.

MISCELLANEOUS

Testimony Engineer; M. Am. Soc. C.E.; competent to take the witness stand as expert in the fields of water supply, storm drainage, sewerage, and valuations. Able to acquit himself well on the stand as a result of broad engineering experience as well as close association with legal matters. D-704.

TEACHING

Structural Engineer; Assoc. M. Am. Soc. C.E.; unmarried; 31; undergraduate and graduate degrees in mathematics and engineering from leading universities; 7 years experience on the design of all types of structures, steel and concrete. Desires position teaching structural engineering, applied mechanics, physics, or mathematics. D-1860.

Civil Engineer; Jun. Am. Soc. C.E.; 30; single; B.S. in civil engineering, Pennsylvania State College; majored in city planning and highway engineering; 9 years experience, general construction; experienced instructor, author, public speaker, and executive; desires position as instructor, research or executive in civil engineering. D-2776.

Civil Engineer; Jun. Am. Soc. C.E.; 27; single; master's degree in C.E., Cornell University; 3 years experience with steel companies and general contractors; 3 years experience in all classes of surveys, including triangulation and hydrography. Desires teaching, engineering, or surveying position. Location immaterial. Salary secondary. D-2384.

Civil Engineer; Jun. Am. Soc. C.E.; 26; married; B.S. in C.E., Lafayette College, 1929; M.S., University of Minnesota, 1933; $1\frac{1}{4}$ years as structural detailer; 4 years as instructor in Mid-Western state university; 4 summers practical surveying; 1 summer highway inspection. Desires position teaching structures, surveying, mathematics, or mechanics. Location immaterial. C-6966.

RECENT BOOKS

New books of interest to Civil Engineers, donated by the publishers to the Engineering Societies Library, or to the Society's Reading Room, will be found listed here. A comprehensive statement regarding the service which the Library makes available to members is to be found on page 87 of the Year Book for 1933. These notes regarding the books are taken from the books themselves, and this Society is not responsible for them.

Book of A.S.T.M. Tentative Standards, 1933. Philadelphia, American Society for Testing Materials, 1933. 1136 pp., illus., diagrs., charts, tables, 9 × 6 in., paper, $7; cloth, $8.

This annual publication contains all the specifications, methods of test, and definitions of terms that the Society has approved tentatively, but has not adopted as standards. Among the new subjects treated are structural steel, steel plates and castings, steel pipe, impact testing, clay wall and floor tile, ready-mixed concrete and many others.

Book of Stainless Steels, Corrosion Resisting and Heat Resisting Chromium Alloys. Ed. by E. E. Thum. Cleveland, Ohio, American Society for Steel Treating, 1933. 631 pp., illus., diagrs., charts, tables, 9 × 6 in., cloth, $5.

The manufacture, properties, and uses of corrosion- and heat-resistant chromium alloys are discussed in this book, in which a large number of authorities have collaborated. American methods of production and fabrication are described in detail; the properties of the typical alloys are presented; and the requirements of a large number of consuming industries are explained. A useful classified list of trade names is included.

British Bridges, an Illustrated Technical and Historical Record, with a Foreword by Hon. Oliver Stanley, an Introduction by J. Buchan, and a Paper on Bridge Development by C. H. Bressey. London, Public Works, Roads and Transport Congress, 1933. 498 pp., illus., diagrs., 10 × 8 in., stiff boards, cloth back, 10s. 6d.

Descriptions of 443 British bridges, chiefly compiled from information supplied by the officials responsible for their maintenance. Photographs are provided for over three hundred of the most interesting from the historical and technical points of view. A valuable introductory essay upon the development of road bridges in Great Britain.

Dynamics of Earthquake-Resistant Structures. By J. J. Creskoff. New York and London, McGraw-Hill Book Co., 1934. 127 pp., diagrs., charts, tables, 9 × 6 in., cloth, $2.50.

The problem of designing structures that are resistant to earthquakes is primarily a dynamic rather than a static one. In this treatise dynamic methods are applied and formulas developed that make possible the design of earthquake-resisting buildings at costs but slightly above those of ordinary structures.

Die Fliesseigenschaften von Abwasserschlamm. (Beihefte zum Gesundheits-Ingenieur, Reihe 2, Heft 14.) By W. Merkel. Munich and Berlin, R. Oldenbourg, 1934. 27 pp., illus., diagrs., charts, tables, 12 × 8 in., paper, 4.50 rm.

This pamphlet throws new light upon the flow of plastics generally. The effect of pipe friction, water, temperature, and various constituents is described. Curves are given showing their effect upon the pumping of sewage sludge, with directions for extending them to coal sludge, paper pulp, tar, concrete, and other materials.

Eine Lösung für die Berechnung der Biegsamen Rechteckigen Platten. By S. Iguchi. Berlin, Julius Springer, 1933. 56 pp., diagrs., charts, tables, 10 × 6 in., paper, 5 rm.

The behavior of loaded isotropic rectangular plates is of interest both to students of the theory of elasticity and to structural engineers. Previous solutions of the problem have chiefly been applicable to special cases with prescribed loads and conditions. Dr. Iguchi here gives a general solution, applicable to any case, and presents formulas for a number of special cases.

The Great Lakes—St. Lawrence Deep Waterway to the Sea. By T. Ireland. New York and London, G. P. Putman's Sons, 1934. 223 pp., illus., maps, 8 × 5 in., cloth, $2.

The effect of the waterway upon shipping rates and upon railways, its cost, the arguments for and against the project, its probable use, and other questions are discussed in this volume. The author is an ardent advocate of the plan.

Grundlagen des Eisenbetonbaues. (Sammlung Göschen 1078.) By A. Troche. Berlin & Leipzig, Walter de Gruyter & Co., 1933. 143 pp., diagrs., tables, 6 × 4 in., cloth, 1.62 rm.

The essentials of reinforced-concrete construction are compressed into remarkably small compass in this little book. The basic forms of concrete members, the properties of reinforced concrete, and its behavior under loads are discussed practically, and numerous worked-out examples are given.

Power Supply Economics. By J. D. Justin and W. G. Mervine. New York, John Wiley & Sons, 1934. 276 pp., illus., charts, maps, tables, 9 × 6 in., cloth, $3.50.

This volume discusses load predictions, the internal economics of steam-electric and hydroelectric plants and the cost of power from each, peak-load plants, oil-engine plants, purchased power, and similar topics. It sets forth the general economic principles governing the selection of the best solution.

Practical Designing in Reinforced Concrete, Part 2. By M. T. Cantell. London, E. & F. N. Spon; New York, Spon & Chamberlain, 1933. 291 pp., illus., diagrs., charts, tables, 9 × 6 in., cloth, 12s. 6d.

Based upon experience in England, Canada, and the United States, this book is intended to comply with practice in each of these countries. The first volume, which appeared some years ago, discussed general matters and the design of beams, floors, and columns. The present volume continues these subjects and discusses such topics as walls, safety vaults, roofs, tanks, swimming pools, bunkers, water mains, and foundations.

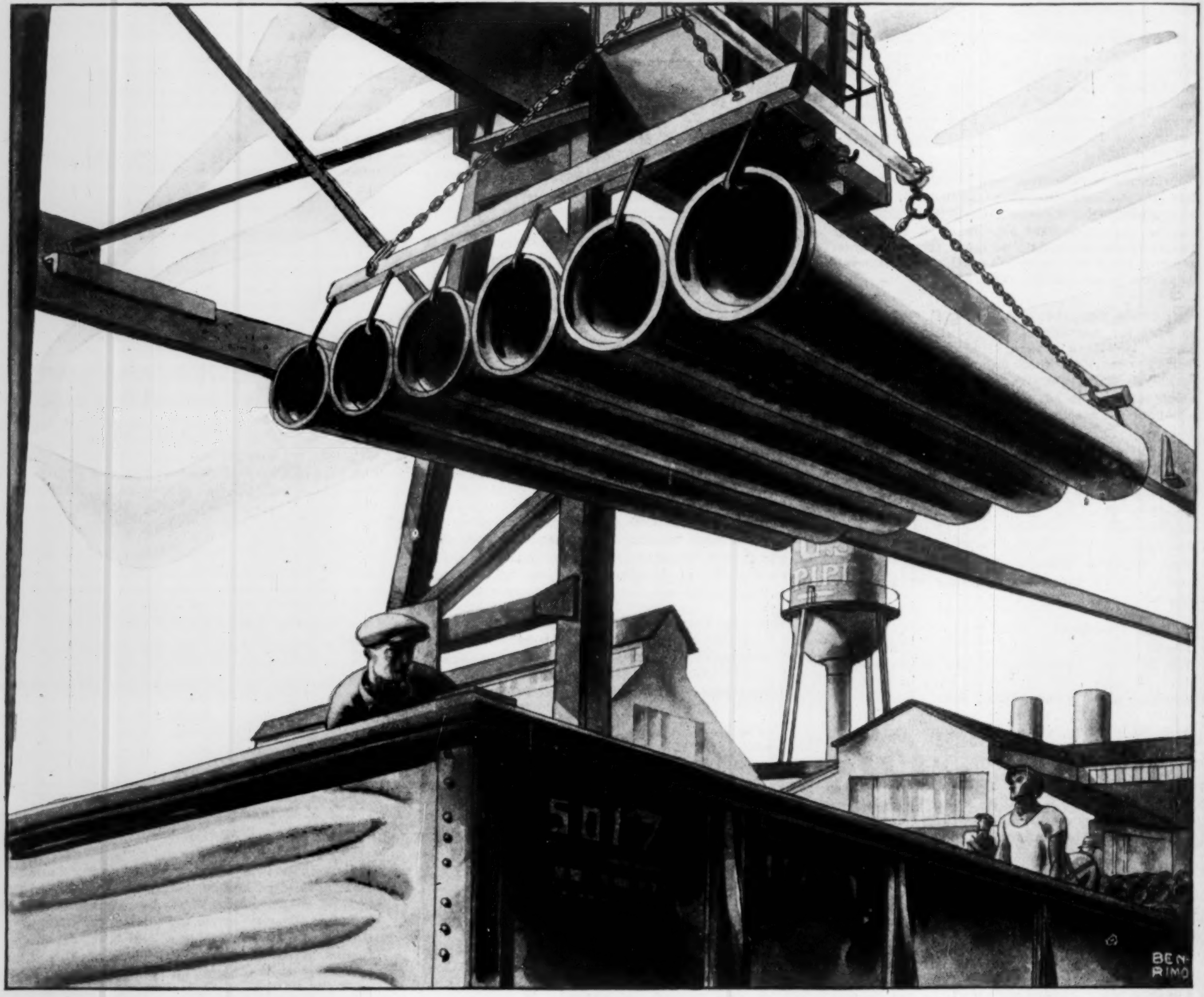
Rebuilding of Blighted Areas, a Study of the Neighborhood Unit in Replanning and Plot Assemblage. By C. A. Perry. New York, Regional Plan Association, 1933. 59 pp., illus., diagrs., charts, tables, 11 × 9 in., cloth, $2.

This timely publication shows what may be done to reclaim a "blighted" area in a city by treating it as a unit. Taking as an example an actual area in New York City, the author presents several plans for its reconstruction and computes the cost of rehabilitation and maintenance. One section of the book is devoted to the problem of plot assemblage.

Termites and Termite Control. Edit. by C. A. Kofoid, S. F. Light, A. C. Horner, M. Randall, W. B. Herms, and E. E. Bowe. Berkeley, Calif., University of California Press, 1934. 734 pp., illus., diagrs., charts, tables, 10 × 6 in., cloth, $5.

This important volume provides a comprehensive account of our knowledge of termites in the United States and neighboring countries, and of methods for preventing and controlling damage to buildings, electric lines, and other structures. The book is the work of a number of prominent zoologists, chemists, and engineers, who have devoted several years to the problem. Specific recommendations for the prevention and repair of termite damage are given, which will be welcomed by engineers and architects.

SUPER-DE LAVAUD PIPE



From The Plant

The United States Pipe and Foundry Company has taken a long step towards reducing the hazard of damage to which all pipe is subject in transit, unloading and distribution. The hazard remains beyond our control but the odds are now overwhelmingly in favor of the pipe. In Super-de Lavaud Pipe we offer a cast iron pipe endowed with maximum protection against handling hazards — a pipe that is *shatter-proofed* to the extent that

IMPACT-RESISTANCE IS INCREASED 100%

Super-de Lavaud Cast Iron Pipe is centrifugally cast by a patented improved process developed in our Research Laboratory. We have been producing and shipping Super-de Lavaud Pipe for more than a year. It has the same high tensile strength — the concentricity — the self-centering shoulder in the bell — in fact, every advantage and economy of de Lavaud Pipe as hitherto made *plus an extraordinary increase in impact resistance.*